TWC Reg. No. 31052

TEXAS WATER COMMISSION
Comprehensive GW Monitoring Evaluation (CME) Report

CONTENTS SHEET

FACILITY NAME Denka Chemical Corporation

- ✓ 1. Code Sheet (0814)
- ____ 2. Interoffice Memorandum (IOM)
- ✓ 3. Inspection Cover Sheet
- ✓ 4. Technical Report, with supporting Attachments
  - ✓ A. Monitoring System
  - * B. Sampling Procedures
  - * C. Analysis and Results
  - ✓ D. Records and Response
- ____ 5. EV Inspection Checklist (if joint inspection with District Office)
- ✓ 6. Notice of Violation (NOV) / Enforcement Letter to Facility
- ____ 7. Other (describe) _____

* If a required Checklist is omitted, Explain: The sampling event (between the TWC and Denka) was completed on February 25, 1986. Upon receipt of the data, Sections 4B and 4C will be completed.

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TWC Solid Waste Inspection Report
(TAC 335.191-195)

GROUND WATER MONITORING CHECKLIST

1. GROUND WATER MONITORING STATUS:
Complete the table for each Waste Management Area (WMA):

WMA	Description	Activity Status	Monitoring Status	Number of Wells
1	upper malec pond (closed) lower malec pond, runoff pond, storm water pond	Active	Quarterly	2 3 U D
2	aeration ponds	Active	no data has yet been submitted	1 2 U D
3				U D
4				U D

Give date of approval for waivers, alternate plan, or assessment plan, as applicable: TDWR (now the TWC) denied Denka's request for waiver of ground water monitoring on 5-17-83. TDWR approved Denka's groundwater quality assessment plan on 9-14-88

2. Provide a diagram locating each monitoring well and waste site(s). List depths, diameter and completion data on each well not included on the previous inspection. Attachment A-9 and Attachment A-66

3. Has the following been installed in the uppermost aquifer around each Waste Management Area(s):

			***
a. At least one hydraulically upgradient well?	YES X	NO ___	
b. At least three hydraulically downgradient wells?	YES ___	NO X	

c. Indicate WMA(s) that that are not compliant: WMA 1 and WMA 2

d. Describe possible problems on Comments Sheet.

4. If the WMA includes multiple waste management facilities, is each facility adequately monitored? N/A ___ YES ___ NO X

5. Does the facility have a **GW Sampling and Analysis Plan**? YES X NO ___
Does it adequately address:

a. Sample collection procedures	YES X	NO ___
b. Sample preservation and shipment	YES X	NO ___
c. Analytical procedures	YES X	NO ___
d. Chain of custody procedures	YES X	NO ___

6. Does the facility have an adequate **GW Quality Assessment Plan Outline**? YES X NO ___

7. If the company is performing an alternate groundwater monitoring program or a partial waiver monitoring program, is an approved Sampling and Analysis Plan followed? N/A X YES ___ NO ___

NOTE: Complete the "GW Sampling Procedures Checklist", when observing well sampling procedures or co-sampling monitor wells at the facility.

*** An entry in this column indicates corrective action/response is needed.

8. Have records been kept of:

a. Analyses for ground water parameters?		YES X	NO	***
b. Calculations of means and variances?		YES	NO X	
c. Water surface elevations taken at each well sampling event?		YES X	NO	
d. Calculations of significant differences?	N/A	YES	NO X	
e. Analyses of duplicate samples for contamination confirmation?	N/A	YES X	NO	
f. Analyses of samples taken as a result of implementing the Ground Water Quality Assessment Plan?	N/A	YES X	NO	
g. Results of Ground Water Quality Assessment Plan?	N/A	YES X	NO	
(1). Rates of Migration?		YES	NO X	
(2). Concentration of hazardous waste and/or constituents thereof?		YES X	NO	
(3). Analyses of quarterly ground water samples?		YES X	NO	
h. Copies of **annual reports** of the groundwater monitoring program?		YES X	NO	

9. Are self-reporting data being submitted on the appropriate TWC forms? YES ___ NO X

NOTE: Complete the remaining checklists as applicable to each Waste Management Area

Comments: WMA 1 and WMA 2 do not appear to have a sufficient number of downgradient wells. The horizontal spacing of the wells is too large and it is uncertain if the wells are monitoring the same zone. In addition, not all of the downgradient wells appear to be placed immediately adjacent to the waste management areas, not more than thirty feet downgradient from the downgradient limit of the waste management area or as approved by the TWC

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GW ASSESSMENT MONITORING

Waste Management Area(s) WMA 1

1. Has the facility started to implement an approved Ground Water Quality Assessment Plan? N/A___ YES X NO___ ***
   Give date plan was started plan approved. 9-14-83

2. If the plan is in progress, give projected completion date _____ and describe actions to date: _____

   a. Is the facility on schedule? N/A X YES___ NO___

3. If the plan has been completed, give date of Ground Water Quality Assessment **report:** 9-21-84

4. Do results indicate that hazardous waste or constituents have been detected? N/A___ YES X NO___

   a. If yes, has a Quarterly Assessment Monitoring Program been implemented? YES X NO___

   b. If no, was detection monitoring reinstated? YES___ NO___

   c. If the facility has not responded appropriately, explain why in comments.

   NOTE: If answer to 4b is yes, Stop Here.

5. List the hazardous waste constituents detected: benzene, toluene, ethyl-benzene, trichloroethylene, methylene chloride, trichloroethylene, and tetrachloroethane.

6. Has the facility Sampling and Analysis Plan been revised to include these parameters? toluene and benzene N/A___ YES X NO___

7. Quarterly, since completion of the assessment, has the facility continued to:

   a. Sample and analyze for hazardous waste or constituents? N/A___ YES X NO___

   b. Determine rate and extent of migration of hazardous waste or constituents? N/A___ YES___ NO X

*** An entry in this column indicates corrective action/response is needed.

8. Yearly, has the facility reported the results of the assessment program (with annual waste report), to include the calculated (or measured) rate of migration of hazardous waste or constituents in ground water during the reporting period? N/A___ YES___ NO X ***

9. If t-test failures have occurred at the WMA during its post-closure care period, has facility complied with:

   a. Retesting to confirm t-test failures? N/A X YES___ NO___

   b. Notifying TWC within 7 days of confirmation? N/A X YES___ NO___

   c. Submittal of approved plan? N/A X YES___ NO___

   d. Completion of approved plan? N/A X YES___ NO___

10. Does the WMA contain a "regulated unit"* subject to 40 CFR 264 Subpart F compliance monitoring requirements? N/A___ YES X NO___

   a. If yes, has the assessment detected hazardous waste or constituents in ground water at this WMA? N/A___ YES X NO___

   b. If yes has the facility sampled and analyzed for all hazardous waste constituents (Appendix VIII, 40 CFR 261) to characterize the plume in accordance with with 40 CFR270.14(c)(4)? N/A___ YES___ NO Y

   c. If no, report this information to the TWC Groundwater Enforcement Unit in the Central Office.

Comments: The company should continue to determine the rate and extent of migration of hazardous wastes or constituents.

* Land Disposal facility that received hazardous waste after July 26, 1982.
*** An entry in this column indicates corrective action/response is needed.

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Technical Report
Comprehensive GW Monitoring Evaluation (CME)

INTRODUCTION

1. COMPANY: Denka Chemical Corporation

Process Description: see continuation page entitled Process Description and Wastemanagement Units

Plant Site has been in operation since: A rubber manufacturing facility has been in operation at the facility since the early 1940's.

2. PHYSIOGRAPHY AND CLIMATE

a. Site Topography- Attachment A-1 (indicate site location directly on map or reproduction)

b. Average Annual: Rainfall 48"/yr Temperature 80°F Evaporation 51"

c. Surficial Soils Map- Attachment A-2

d. Surface water bodies or other recharge/discharge features or wells: The facility is located adjacent to Suiss Bayou and discharges directly to the water body. The primary water supply in the area is from inland lakes and reservoirs. One groundwater user is Petro-Tex Chemical Corporation with an industrial well at a depth of +600 ft.

e. Other pertinent features- use continuation sheet.

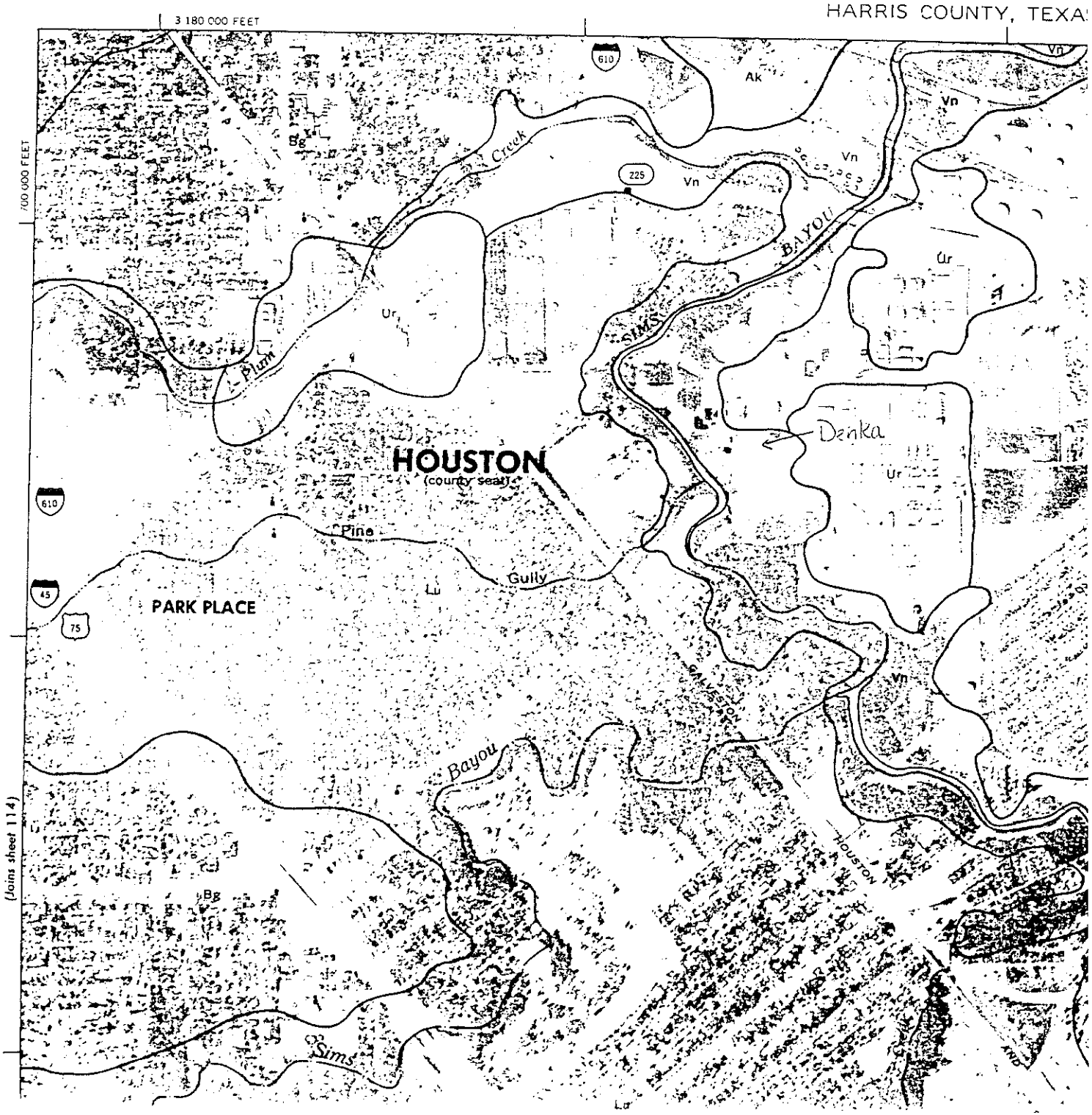
3. WASTE MANAGEMENT UNITS Requiring Ground Water Monitoring

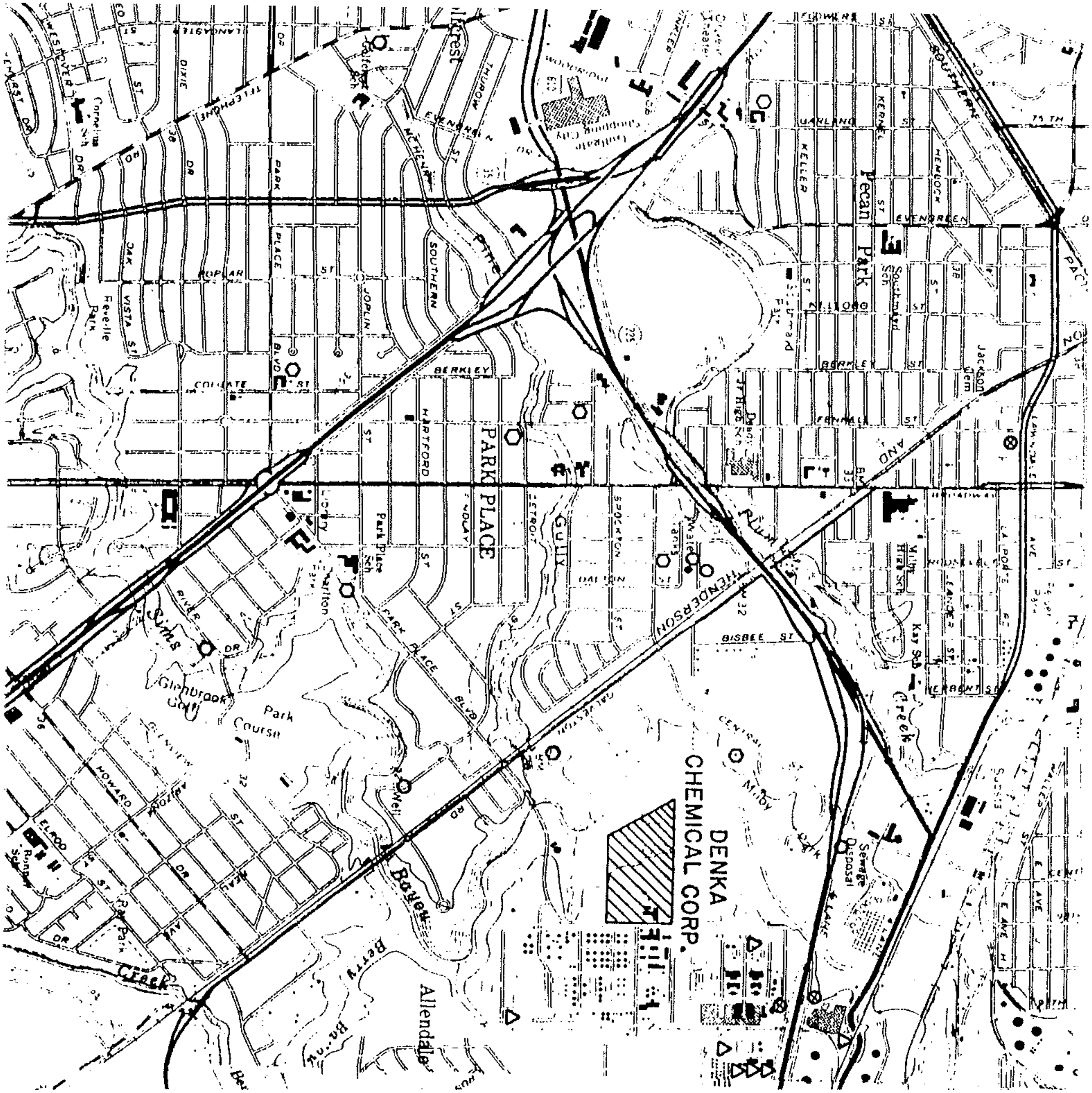
- Indicate Units on Site Diagram: Attachment(s) A-9
- Indicate Waste Management Area (WMA) boundaries on Site Diagram

Unit	Size	Yr in Service	Status*	Construction
upper oxidic pond	1.2 million gallon for the upper and lower	1963	CI-1981	unlined
lower oxidic pond		1963	A	unlined
inlet pond		1963	A	unlined
stormwater pond	1 million gal	1975	A	3 ft clay

NOTE: Use continuation sheet if necessary.

* A=Active CI=Closed I=Inactive R=Regulated Unit NH=NonHazardous


3 180 000 FEET
HARRIS COUNTY, TEXAS
700 000 FEET
(Joins sheet 114)
610
225
45
75
Bg
Ak
Vn
Ur
Creek
BAYOU
SIMS
Plum
HOUSTON
(county seat)
Denka
Pine
Gully
PARK PLACE
Bayou
Sims
HOUSTON



PARK PLACE
Pecan Park
DENKA
CHEMICAL CORP.
Glenbrook
Golf
Park
Course
Allendale
Gully
Sims
Bayou
Berry
Creek
HENDERSON
EVERGREEN
BERKLEY
GARLAND
BISBEE ST
HERBERT ST
COLGATE
HARTFORD
JOPLIN
SOUTHERN
POPLAR
PARK PLACE BLVD
Park Place Sch
Reveille Park
Sewage Disposal
Jackson Cem
Kay Sch
Milby High Sch

Unit	Size	Service	Status*	Construction
aeration ponds				
(north)	4½ million gal	1965	A	
(middle)	4½ million gal	1965	A	
(south)	4½ million gal	1965	A	

NOTE: Use continuation sheet if necessary.

* A=Active Cl=Closed I=Inactive R=Regulated Unit NH=NonHazardous

Process Description and Waste Management Units

Denka Chemical Corporation manufactures neoprene rubber and maleic anhydride at a facility located in the City of Houston, Harris County, Texas, adjacent to Sims Bayou near the intersection of Route 225 and East Loop Interstate 610. The facility is bounded on the north by the Goodyear Synthetic Rubber Corporation, on the east by the Texas Petrochemical Corporation on the south by residential properties and on the west by Sims Bayou.

In 1977, Denka Chemical Corporation purchased the neoprene plant built in 1970 (for the manufacture of neoprene rubber) and the maleic anhydride plant built in the mid-1960's (for the manufacture of maleic anhydride) from Petro-Tex Chemical Corporation (now Texas Petrochemical Corporation). The facility itself has been in operation since the early 1940's.

Neoprene rubber is manufactured by Denka in a two-step process. The principal feedstocks employed in the first step, butadiene and chlorine, are supplied to the facility by pipeline and railroad tank car respectively. These substances react in the vapor phase to yield a mixture of dicholorobutenes, which are then separated from the crude product mix by fractionation. The overhead from the fractionation column is recycled to the chlorination reactor. Isomerization of the mixed dichlorobutenes yields principally 3,4-dichloro-1-butene. This product is dehydrochlorinated with caustic soda to form chloroprene. Both chloroprene and excess 3,4-dichloro-1-butene are stored in tanks equipped with hydrocarbon scrubbers. Spent caustic is discharged to the aeration ponds.

Chloroprene is polymerized in the second step of the manufacture of neoprene rubber. Chloroprene, initiator, and soap are introduced into a reactor where polymerization occurs. The crude product is then sent to a stripper where unreacted monomer is recovered from the finished elastomer latex by steam stripping under vacuum.

Benzene was the principal feedstock employed in the maleic acid plant from the mid-1960's to 1981; now maleic anhydride is generated by air oxidation of butane in the presence of a catalyst.

The wastewater from both the neoprene and maleic anhydride manufacturing process are combined and treated in the facility's aeration lagoons. After clarification, the treated wastewater is discharged to Sim Bayou. The

aeration lagoons also receive process wastewater from the adjoining Texas Petrochemical facility, as the wastewater system is jointly owned by Denka and Texas Petrochemical Corporation.

The lower maleic pond is unlined and receives wastewater from the maleic anhydride and tetahydrophthalic anhydride processes. Maleic and fumeric acid, present in the wastewater settle out and the supernatant is sent to the aeration ponds. The wastewater from the maleic pond is classified as hazardous based on the characteristic of corrosivity.

According to Denka the storm-water pond is lined with 3 feet of clay and has a capacity of approximately one million gallons. The pond receives dirty storm-water runoff from process areas associated with the manufacturing processes. Runoff collected in the pond is sent to the aeration ponds for treatment. The contents of the pond is considered by TWC to be hazardous. Storm-water runoff from other areas of the facility not associated with manufacturing is diverted to Sims Bayou.

A. Ground Water Monitoring System

1. Regional Geology (Houston Sheet, Geol. Atlas of Texas)

a. Physiographic province Brazos Delta Plain of the Western Gulf Coast Plain

b. Formation(s) Denka is situated upon the outcropping Beaumont (cont below)

Lithology see below

Regional dip and gradient The units dip to the south and southeast at (cont on next page)

c. Depth to top/bottom of useable quality (≤10,000 mg/l TDS) ground water is at 600 feet^ (below MSL for the base of the Chicot and at 2500 ft below MSL for the base of the Evangeline), determined by the Denka Chemical Corporation, Groundwater Compliance Application and Geology Report of the Part B Application.

d. Regional direction of ground water flow within the lower part of the Chicot and in the Evangeline are west-southwest and west-northwest, respectively determined by the Denka Part B Application. A heavy pumping influence (cont)

e. Is site on recharge area of major/minor named aquifer (Y/(N))?

The Beaumont Clay near land surface in much of southern Harris

f. Part B permit application - Geology Report: ~~pages~~ Attachment L.

Comments: 1b. Formation(s) continued. Clay formation of Pleistocene age. The Beaumont makes up most of the Upper Chicot aquifer. The lower Chicot aquifer consists of the Montgomery, Bentley, and Willis sand formations of Pleistocene age. Underlying these units are the Evangeline and Burkeville.

1b. Lithology continued. The Beaumont is composed of mostly clay, silt, and sand interbeds and makes up most of the Upper Chicot aquifer. The lower Chicot is predominantly sand, shale, and clay. The Burkeville confining layer, composed of silts, clays, and some sands, underlies the Evangeline and functions to retard the exchange of water between the Evangeline and the deeper Jasper

1b. Regional dip and gradient continued. increasingly greater angles as a result of increased sediment overburden. Hydraulic gradients within the shallow silt between up- and downgradient wells are calculated in the range of 0.0011 to 0.0095, with flow generally toward Sims Bayou.

1c. continued. The Chicot aquifer has about 700 feet of thickness beneath the site. The Evangeline Aquifer (1,800 feet thick), although much deeper than the Chicot is the most sought after and utilized water-bearing zone in the Houston Industrial sector. The general range for total dissolved solids in the water for these aquifers is 200 to 600 milligrams per liter.

1a. continued. in this industrial area has created a cone of depression around the site area which would cause variance in the deeper regional aquifer flow directions. The shallow groundwater flow across the overall Houston plant site is generally from the east-northeast.

2. Site Hydrogeology

a. Attachment A-3 - Site diagram with locations of waste management area(s) [WMA], borings, wells, lines of cross-sections, etc.

b. Site stratigraphy to depth of investigation- ~50 feet:

Unit	Thickness	Description
Shallow Silt	El +3 ft msl to El -19 ft msl	see next page
El -30 ft Sand	El -27 ft msl and El -34 ft msl	see next page
El -45 ft Sand	El -43 to El -47 ft msl	see next page

c. Attachment A-4 -Cross-Section(s)

d. Saturated zone(s) and Aquitard(s)

Unit	Depth Encou.	Saturated Thickness	Potentiometric Rise	Confined/ Unconf.	K	Vertical Gradient
Shallow Silt	El +13 ft msl to El -19 ft msl	1 ft - 26 ft		unconfined		
El -45 ft Sand	El -43 ft msl to El -47 ft msl	5 ft		unconfined		

e. Is first water-bearing zone in hydraulic communication with deeper zone (Y/N)? According to Denka there is poor hydraulic communication between the various sands at the chalene pond location and northward to the plant boundary but that some communication between sands (cont. next page)

f. Is aquitard continuous beneath site (Y/(N))?

g. If yes for e or f, calculate rate of downard vertical migration on Attachment —; Rate — Aquiclude Thickness —

Migration Time There is not sufficient data to calculate the above.

h. Unit(s) monitored during interim status the shallow silt and the El-45 ft. Sand

i. Unit(s) designated as uppermost aquifer in Pt. B the shallow silt and the El - 45 Sand

Concur (Y/N)

2b. continued.

The "shallow silt" is a sandy silt found at variable depths on the site and has been interpretted by Denka to consist of at least two portions which diverge from each other in parts of the plant. This unit is found at shallow depth in the central plant area and in well 5A is substantially deeper.

The "El -30 ft sand" is a red silty sand that appears to be continuous between borings for well nos 21 and 22, at elevations between about -27 and -37 ft msl.

The "lowest permeable zone" investigated is a silt and sand stratum at about El -43 to El -47 ft msl. This stratum is screened by Well Nos. 21 and 22 and is called the "El -45 ft sand."

According to the Denka Geology Report for the Part B some connection may exist between the El -30 ft sand and either the shallow silt or the El -45 ft sand, but the available data indicate poor hydraulic connection between the shallow silt and the El -45 ft sand

Also according to the Denka Part B, stratigraphic and hydrologic data presently available are insufficient to define the sand screened by Well 5A as either a low elevation lobe of the shallow silt or a continuation of the El -30 ft sand. It is Denka's opinion that the sand screened by well 5A is more closely connected to the El -30 ft sand than to the shallow silt.

2. Site Hydrogeology, comments: 2e. continued. May exist south of the storm water detention pond. This possible connection between the various sands may occur near the location of Well 5A, where an old tributary channel to Jones Bayou has been filled in as part of the plant site.

3. Monitor Well Construction

a. Attachment A-5 and 6b -Well construction diagrams.

b. Attachment A-6a -Table of well construction details.

c. Do monitor well installation techniques and materials of construction satisfy 31 TAC 335.192(c)-(Y)/N)?

d. Comments: The company has never submitted the monitoring well logs however the monitor well installation techniques and materials of construction look satisfactory.

4. Site Ground Water Movement

a. Attachment A-7 -Water table/Potentiometric Surface Map. (Indicate inferred flow directions directly on map. Include several maps to show the range of observed water level measurements).

b. Calculate minimum and maximum observed gradients in units of feet/foot. Show on map and list here (11-13-81: 0.0265 ft/ft), (2-18-82: 0.03135 ft/ft), (5-10-82: 0.035 ft/ft), (8-12-82: 0.035 ft/ft), (5-83: 0.025 ft/ft) continued on next page

c. Attachment A-8 -Calculations of average linear velocity (v) for gradients reported above, showing all assumptions. List results here: (11-13-81: 429.66 ft/yr), (2-18-82: 508.29 ft/yr), (5-10-82: 567.5 ft/yr), (8-12-82: 567.5 ft/yr), (5-83: 405.3 ft/yr).

d. Comments: Assume a permeability of 4.7×10^{-3} cm/sec (that is 1.969 ft/min x 60 min/hr x 24 hr/day x 365 day/yr x 4.7×10^{-3} cm/sec)

$\bar{v} = Ki/n = \frac{4,864.1 \text{ ft/yr} \times i}{0.30} = 16213.5i$

The assumed permeability is obtained from data from the

4b continued: (6-83: 0.0236 ft/ft), (12-83: 0.0236 ft/ft), (3-84: 0.029 ft/ft), (6-84: 0.0265 ft/ft), (11-84: 0.0269 ft/ft), (1-85: 0.0229 ft/ft), (4-85: 0.0247 ft/ft), (8-85: 0.026 ft/ft),

4c continued: (6-83: 382.6 ft/yr), (12-83: 382.6 ft/yr), (3-84: 470.2 ft/yr), (6-84: 429.7 ft/yr), (11-84: 436.1 ft/yr), (1-85: 371.3 ft/yr), (4-85: 400.5 ft/yr), (8-85: 421.6 ft/yr)

4d. continued: Groundwater Compliance Plan Application, Denka Chemical Corporation, Houston Plant.

5. Monitor Well Placement

a. Indicate distance(s) of upgradient/background well(s) from WMA

GWM3 is approximately 45 ft from the top of the upgradient pond, GWM4 is approximately 60 ft from the top of the upgradient pond.

b. Are designated upgradient well(s) confirmed as upgradient (Y/N)? [31 TAC 335.192(a)(1)] GWM4 could be used as a background well for both HWMA (the maleic ponds, stormwater, runoff pond area and the aeration ponds area).

c. Are upgradient well placements adequate to yield samples representative of background groundwater quality (Y/N)? [31 TAC 335.192(a)(1)(A)], unaffected by WMA (Y/N)? [31 TAC 335.192(a)(1)(B)]

d. Indicate on the site diagram (Att. 9 above) the lateral spacing, in feet, of downgradient/perimeter monitor wells.

e. Are designated downgradient wells confirmed as downgradient (Y/N)

f. Describe the operator's justification for lateral spacing _____ No justification

g. Is the lateral spacing sufficient to satisfy the performance standard of 31 TAC 335.192(a)(2)? (Y/N). If no, explain in comments. see next page, comments section.

h. Indicate on map and tabulate below the distances of down gradient wells from the edge of WMA along the direction of groundwater flow:

	to the maleic pond and stormwater pond				to the aeration ponds					
Well	1	2	5A		5A	8				
Distance	400'	25'	350'		350'	120'				
Time	371.3 ft/yr / 400 ft = 0.9	14.9 yr	1.1 yr		1.06 yr	3.1 yr				
	*	NSB	*		*					

Calculate groundwater travel time based on v calculated above. Assuming conservative transport, will each well detect contaminants during the active life or post-closure care period. Indicate those wells that will not with (*).

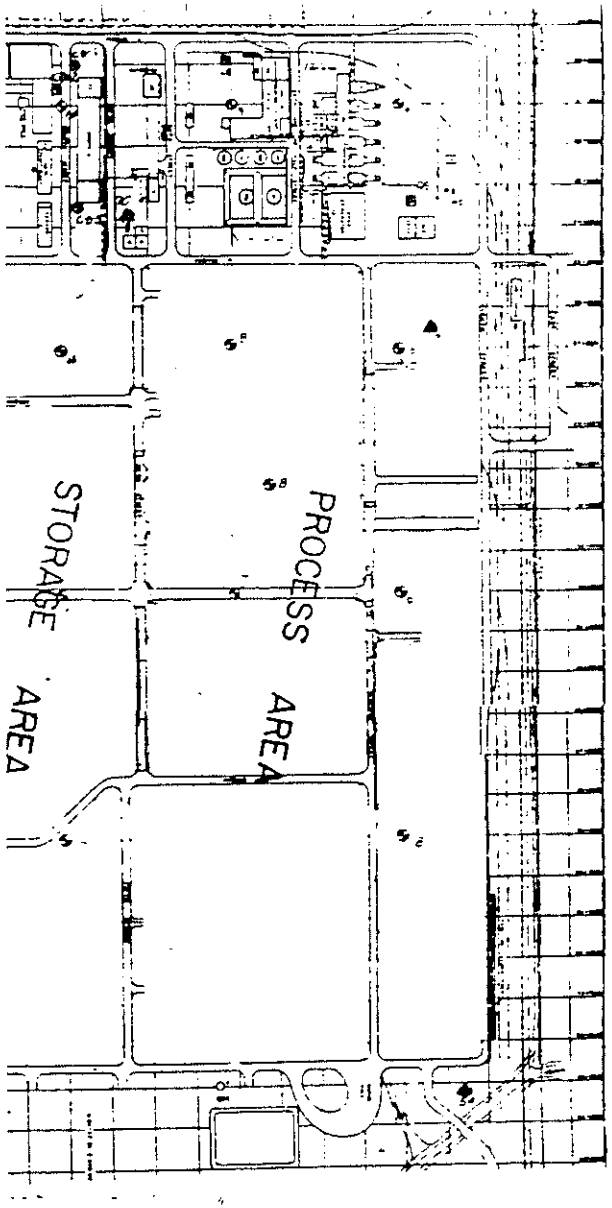
i. Vertical placement- Indicate on cross-sections (Att A-4, above) the screened and gravel-packed intervals of wells and tabulate:

	RCRA	RCRA	RCRA	RCRA	RCRA	NON RCRA	NON RCRA	NON RCRA	NON RCRA	NON RCRA
Well	1	2	3	4	5A	21	22	6	7	8
Screen length	4'	6'	3'	10'	6'	5'	5'	4'	26'	No Data
Aquifer thickness	1-26'	1-26'	1-26'	1-26'	1-26'	≈5'	≈5'	No Logs or Completion Reports have been submitted		
S/U	S	S	S	S	S	S	S	INSUFFICIENT DATA		

S=Satisfactory U=Unsatisfactory

Explain in comments why vertical placement is unsatisfactory [31 TAC 335.192(c)].

Comments: 5g continued: Additional downgradient wells are necessary for both HWM areas (HWM area No. 1 and HWM area No. 2 as designated on Attachment). The downgradient wells do not appear to be located so that all likely pathways of contaminant migration are monitored. Three downgradient wells is the minimum number of wells that can be installed at a HWM area, Denka does not have 3 downgradient wells. The wells should be placed immediately adjacent to the waste management areas, a number of Denka's wells are placed such that they will not allow Denka to immediately detect contaminant migration. The spacing between the downgradient wells is dependent on site subsurface conditions, however, usually the spacing between wells should be 150 ft or less. The spacing between Denka's downgradient wells is substantially greater than 150 ft.



LEGEND

△ 71 PIEZOMETER LOCATION AND NUMBER

⊕ 53 EH & A BORING WITH NO PIEZOMETER

HISTORICAL BORING (BY OTHERS)

NOTE:

1. Piezometer number corresponds to boring number.
2. This exhibit represents a modified version of the exhibit by EH & A.

Attachment A-3

GEO ASSOCIATES

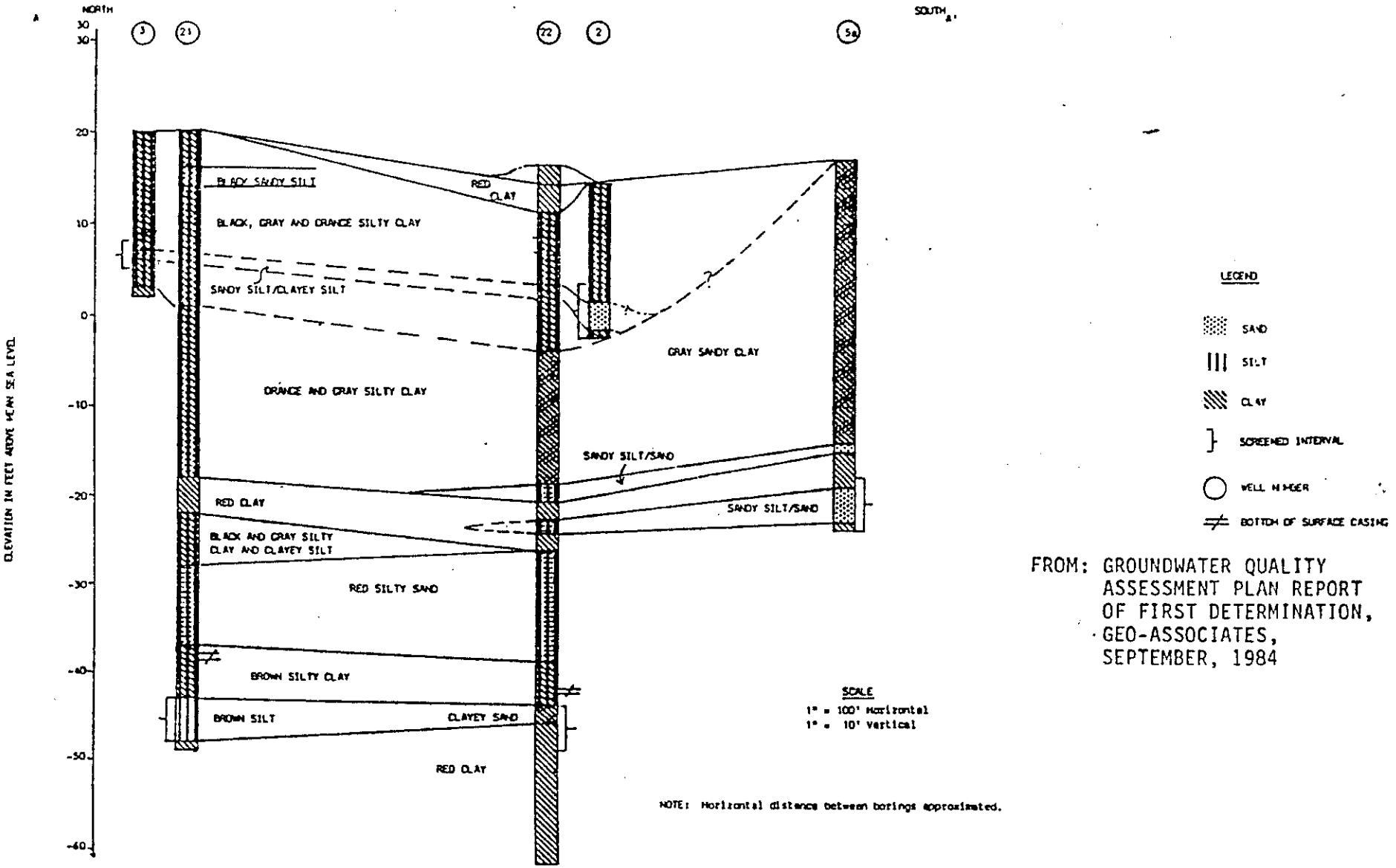
Geotechnical Engineering & Groundwater Hydrology

BORING AND PIEZOMETER LOCATION PLAN
[As reported by Espey, Huston & Associates, Inc., December, 1982]
DENKA CHEMICAL CORPORATION

NO.	DATE	EXHIBIT NUMBER
		11

Attachment A-4

SITE-SPECIFIC GEOLOGIC CROSS-SECTION A-A'

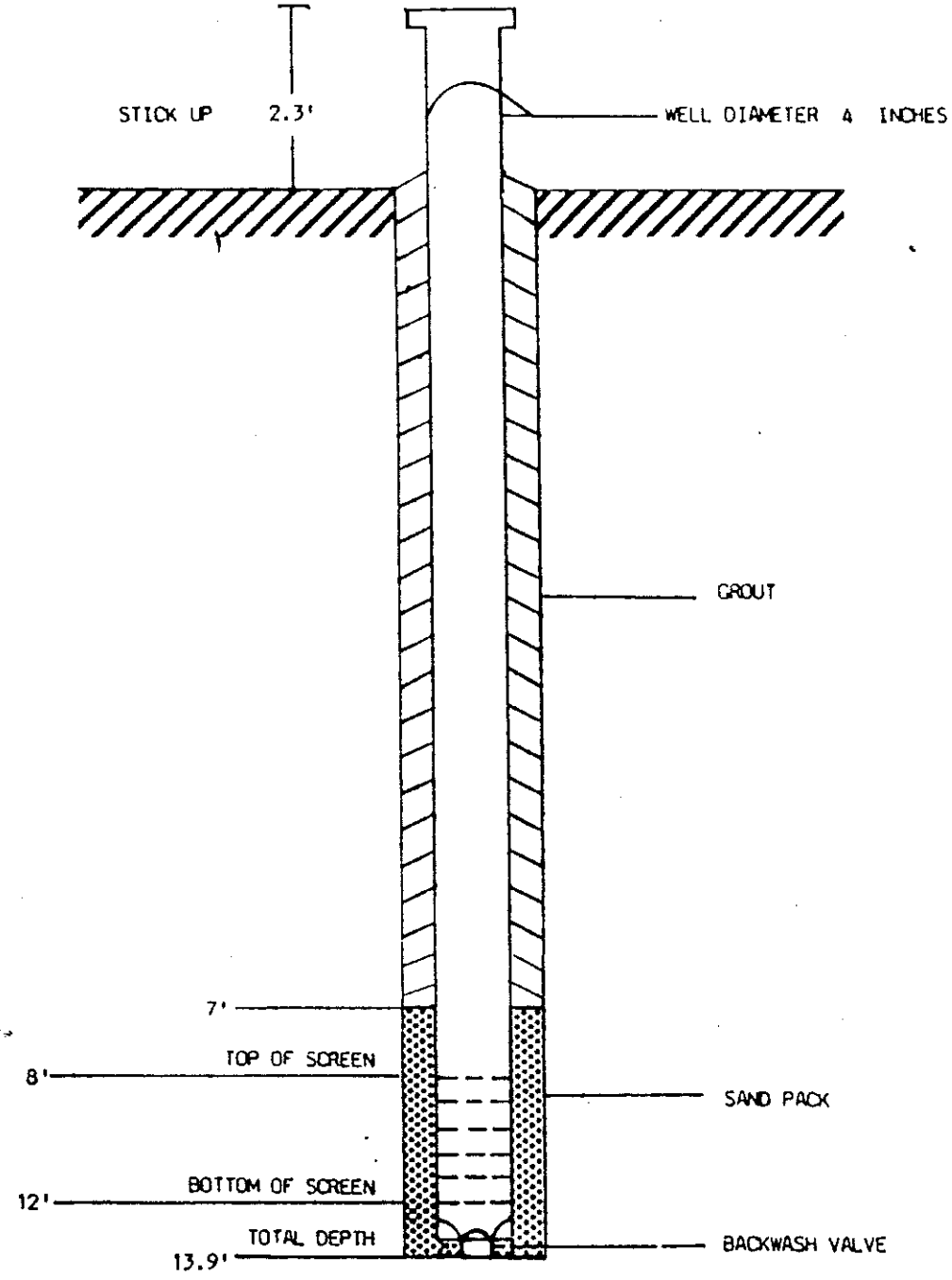


NOTE: Horizontal distance between borings approximated.

FROM: GROUNDWATER QUALITY ASSESSMENT PLAN REPORT OF FIRST DETERMINATION, GEO-ASSOCIATES, SEPTEMBER, 1984

ES ENGINEERING-SCIENCE

Attachment A-5



CASING TYPE: Schedule 40 PVC (glued)

SCREEN TYPE: 0.010" Slotted Schedule 40 PVC

GROUT TYPE: Mortar Mix

NOTE: This exhibit is prepared from information provided on boring logs prepared by Espey, Huston & Associates, Inc. - 1981.

GEO ASSOCIATES

Geotechnical Engineering & Groundwater Hydrology

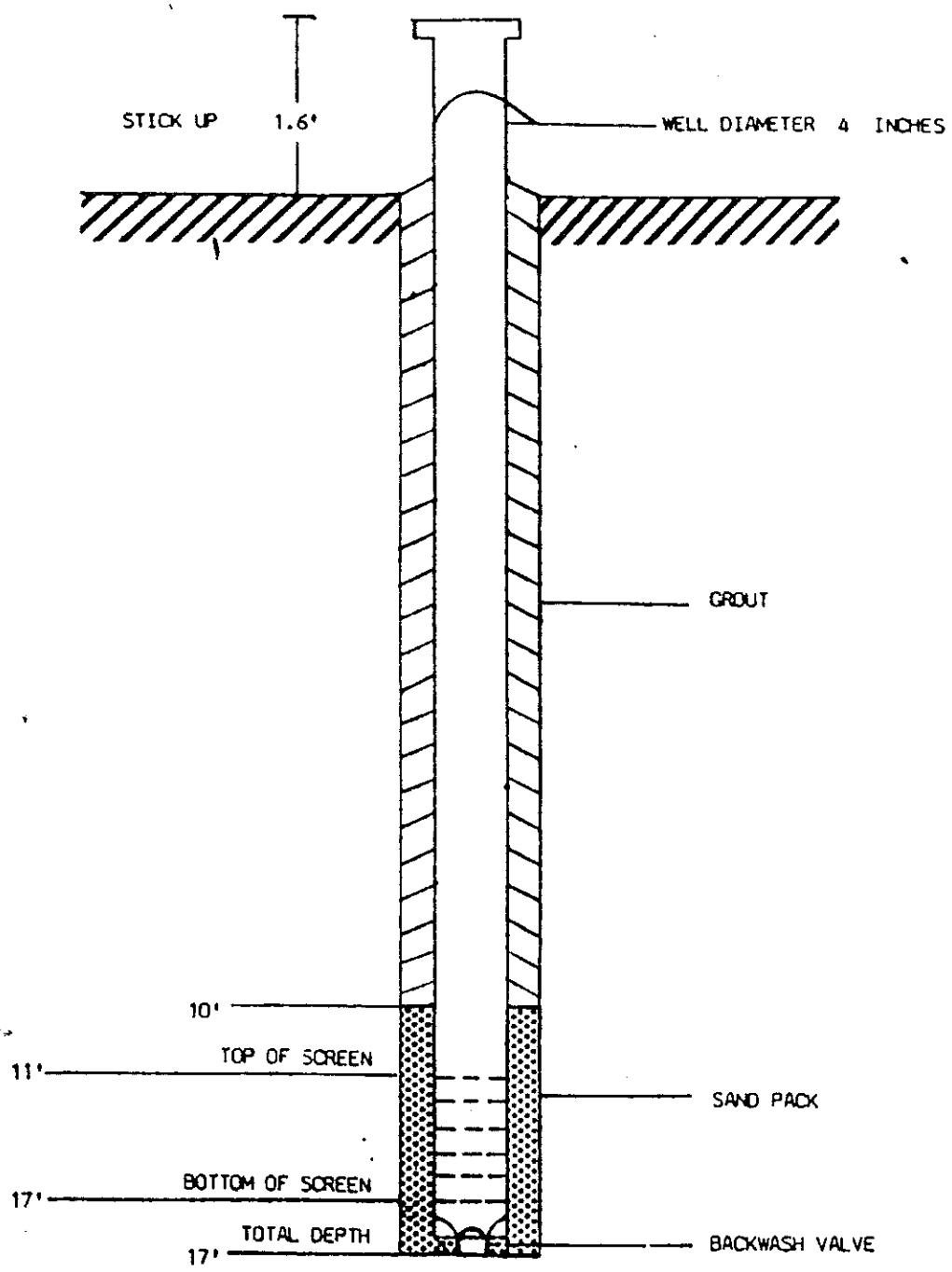
WELL INSTALLATION DETAIL

WELL NO. 1

THE DENKA CHEMICAL CORPORATION

[Installed by Espey, Huston & Assoc., Inc]

NO.	DATE DRILLED	EXHIBIT NUMBER
003	10/19/81	



CASING TYPE: Schedule 40 PVC (glued)

SCREEN TYPE: 0.010" Slotted Schedule 40 PVC

GROUT TYPE: Mortar Mix

NOTE: This exhibit is prepared from information provided on boring logs prepared by Espey, Huston & Associates, Inc. - 1981.

GEO ASSOCIATES

Geotechnical Engineering & Groundwater Hydrology

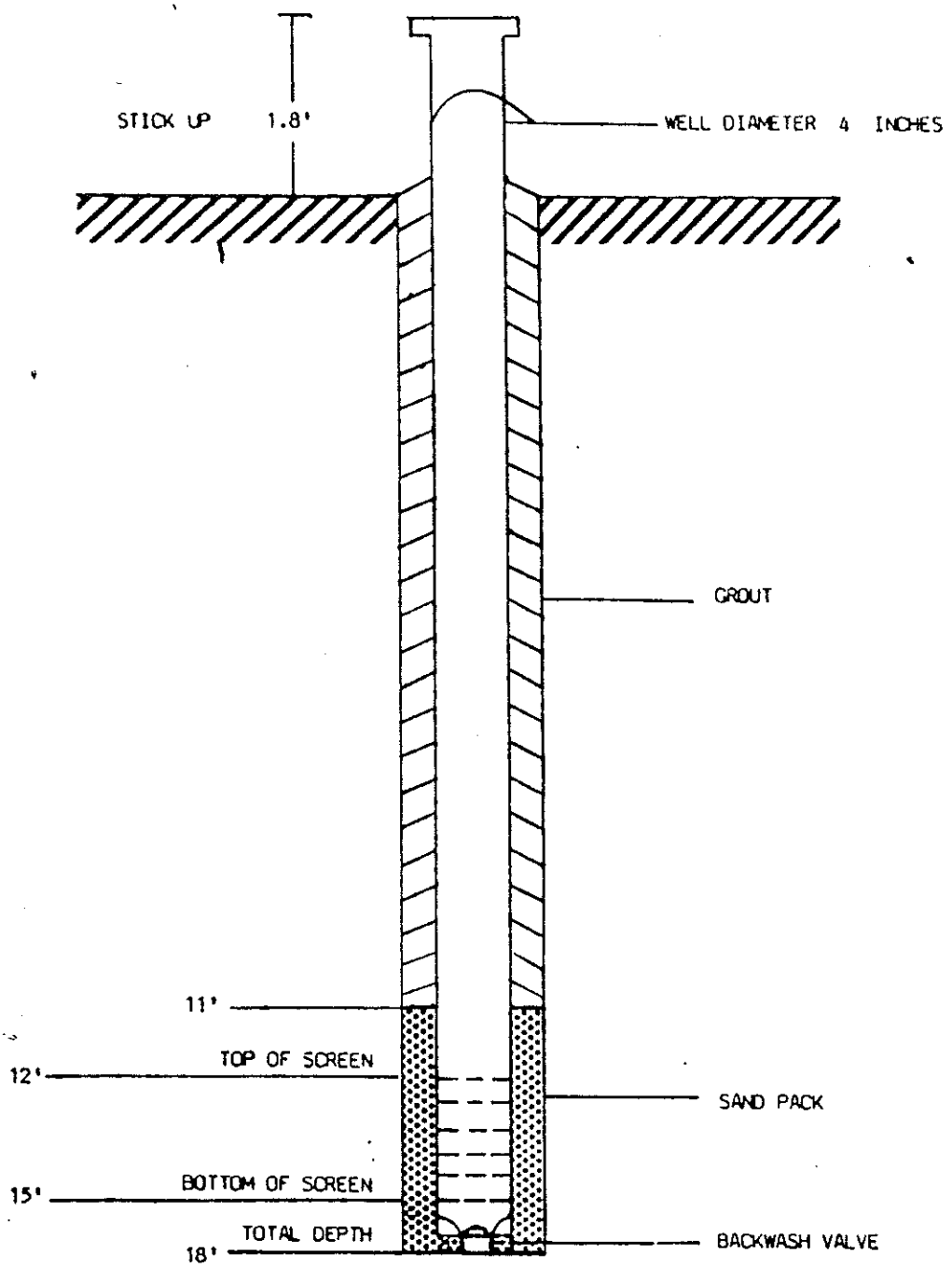
WELL INSTALLATION DETAIL

WELL NO. 2

THE DENKA CHEMICAL CORPORATION

[Installed by Espey, Huston & Assoc., Inc]

NO.	DATE DRILLED	EXHIBIT NUMBER
003	10/21/81	



CASING TYPE: Schedule 40 PVC (glued)

SCREEN TYPE: 0.010" Slotted Schedule 40 PVC

GROUT TYPE: Mortar Mix

NOTE: This exhibit is prepared from information provided on boring logs prepared by Espey, Huston & Associates, Inc. - 1981.

GEO ASSOCIATES

Geotechnical Engineering & Groundwater Hydrology

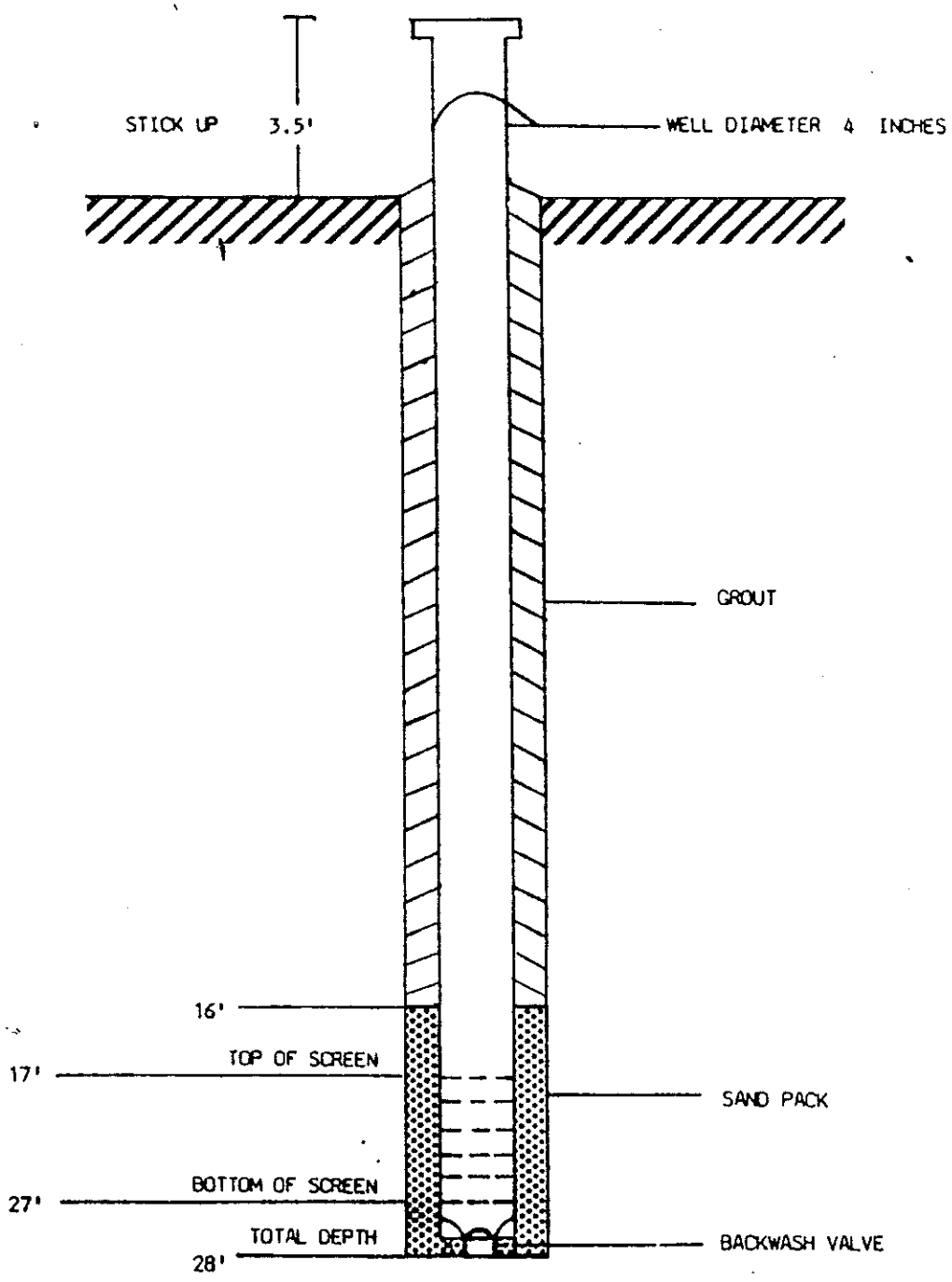
WELL INSTALLATION DETAIL

WELL NO. 3

THE DENKA CHEMICAL CORPORATION

[Installed by Espey, Huston & Assoc., Inc]

NO.	DATE DRILLED	EXHIBIT NUMBER
003	10/19/81	



CASING TYPE: Schedule 40 PVC (glued)

SCREEN TYPE: 0.010" Slotted Schedule 40 PVC

GROUT TYPE: Mortar Mix

NOTE: This exhibit is prepared from information provided on boring logs prepared by Espey, Huston & Associates, Inc. - 1981.

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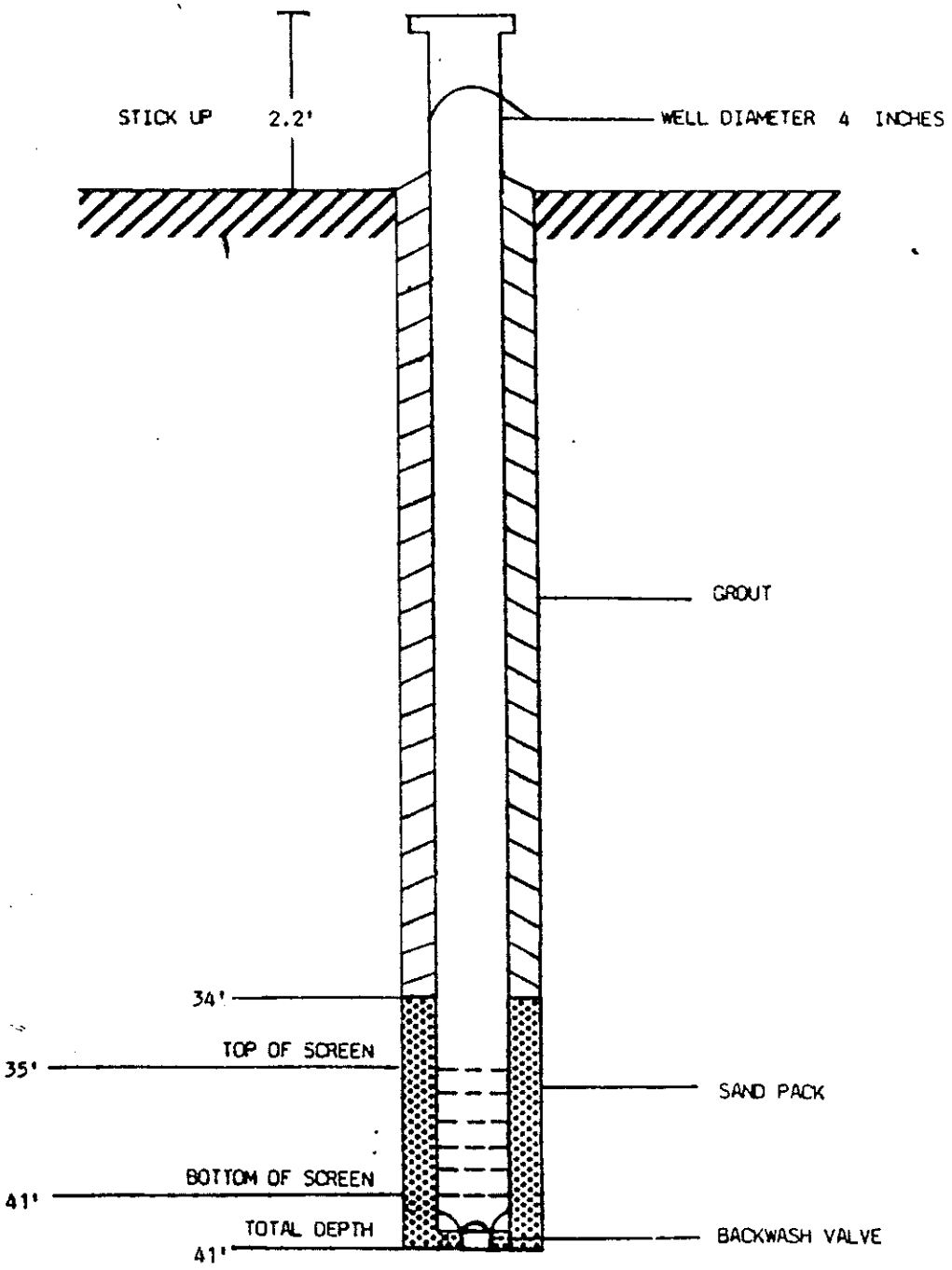
WELL INSTALLATION DETAIL

WELL NO. 4

THE DENKA CHEMICAL CORPORATION

[Installed by Espey, Huston & Assoc., Inc]

NO.	DATE DRILLED	EXHIBIT NUMBER
003	10/20/81	



CASING TYPE: Schedule 40 PVC (glued)

SCREEN TYPE: 0.010" Slotted Schedule 40 PVC

GROUT TYPE: Mortar Mix

NOTE: This exhibit is prepared from information provided on boring logs prepared by Espey, Huston & Associates, Inc. - 1981.

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WELL INSTALLATION DETAIL

WELL NO. 5A

THE DENKA CHEMICAL CORPORATION

[Installed by Espey, Huston & Assoc., Inc]

NO.	DATE DRILLED	EXHIBIT NUMBER
003	2/11/82	

LOG OF BORING NO. 1
DATE DRILLED 10/19/81
TYPE Wash Boring
WATER LEVEL AT 13.3 FT ON 11/2/81
LOCATION Northwest corner of pond area
GROUND EL. 14.26
Top of Pipe El. 16.6

DEPTH (FEET)	SYMBOL	SAMPLES	MATERIAL DESCRIPTION
5			Dark Brown, Black Silty Clay w/shell, rock fragments
10			Dark Brown Sandy Silt
			Clay
15			Total Depth = 13.9'
			Well screen set at approximately 8 to 12 feet below ground surface. Borehole annulus packed with sand through screen section, and cement grouted around well casing to ground surface.

LOG OF BORING NO. 2
DATE DRILLED 10/21/81
TYPE Wash Boring
WATER LEVEL AT 7.3 FT. ON 11/2/81
LOCATION West side of setting ponds
GROUND EL. 14.52
Top or Pipe El. 16.14

DEPTH (FEET)	SYMBOL	SAMPLES	MATERIAL DESCRIPTION
5			Black Silty clay w/orange mottling w/green discoloration w/shell, rock fragments sand seams @ 10.5'
10			
15			Silty Fine to Medium Sand Easy Wash, Smelly
			Black Silty Clay
20			Total Depth = 17'
			Well screen set at approximately 11 to 17 feet below ground surface. Borehole annulus packed with sand through screen section, and cement grouted around well casing to ground surface.

LOG OF BORING NO. 3
DATE DRILLED 10/19/81
TYPE Wash Boring
WATER LEVEL AT 6.1 FT. ON 11/2/81
LOCATION Denka Cooling Towers
GROUND EL. 20.24
Top of Pipe El. 22.08

DEPTH (FEET)	SYMBOL	SAMPLES	MATERIAL DESCRIPTION
5		1	Gray-Black, Silty Clay w/rock, shell fragments w/orange mottling 7'
10			Stiff Orange Silty Clay w/organics
			Sandy Silt/Silty Sand
15			Stiff Orange Silty Clay
			Orange & Tan Sandy Clay
20			T.D. = 18'
			Well screen set at 12 to 15 feet below ground surface. Borehole annulus packed with sand through screen section, and cement grouted around well casing to ground surface.

LOG OF BORING NO. 4
DATE DRILLED 10/20/81
TYPE Wash Boring
WATER LEVEL AT 11.7 FT ON 11/2/81
LOCATION West Side of Control Building
GROUND EL. 24.97
Top of Pipe El. 28.47

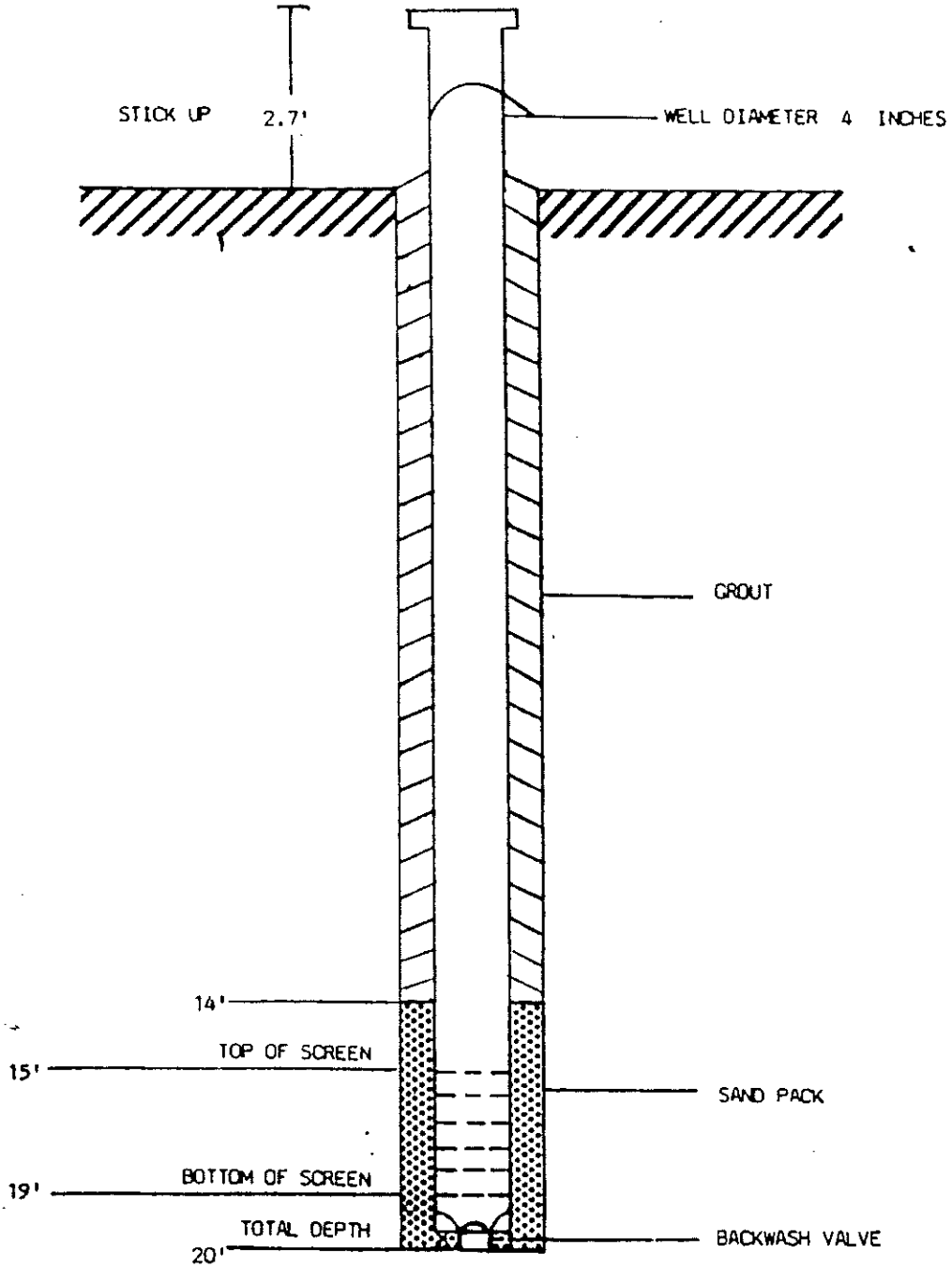
DEPTH (FEET)	SYMBOL	SAMPLES	MATERIAL DESCRIPTION
5			Black & Gray Silty Clay shell & rock - top 6"
10			Orange & Tan Silty Clay w/organics w/calcareous nodules
15			Stiff Orange Silty Clay w/organics
20			Orange Sandy Silt w/micaceous particles
25			Red & Gray Silty Clay
30			T.D. = 28'
			Wellscreen set at approximately 17 to 27 feet below ground surface. Borehole annulus packed with sand through screen section, and cement grouted around well casing to ground surface.

LOG OF BORING NO. 5 A
DATE DRILLED 2/11/82
TYPE Wash Boring
WATER LEVEL AT 14.8 FT. ON
LOCATION South of Neoprene Tanks
GROUND EL 16.98
Top of Pipe El. 19.15

LOG OF BORING NO.
DATE DRILLED
TYPE
WATER LEVEL AT ____ FT. ON
LOCATION
GROUND EL.

DEPTH (FEET)	SYMBOL	SAMPLES	MATERIAL DESCRIPTION
			Orange & Gray Sandy Clay w/calcareous nodules
30			Sand
			Clay
			Sand
40			Clay
			T.D. = 41' Well screen set at approximately 35 to 41 feet below ground surface. Borehole annulus packed with sand through screen interval, and cement grouted around well casing to ground surface.
50			

DEPTH (FEET)	SYMBOL	SAMPLES	MATERIAL DESCRIPTION



CASING TYPE: Schedule 40 PVC (glued)

SCREEN TYPE: 0.010" Slotted Schedule 40 PVC

GROUT TYPE: Mortar Mix

NOTE: This exhibit is prepared from information provided on boring logs prepared by Espey, Huston & Associates, Inc. - 1981.

GEO ASSOCIATES

Geotechnical Engineering & Groundwater Hydrology

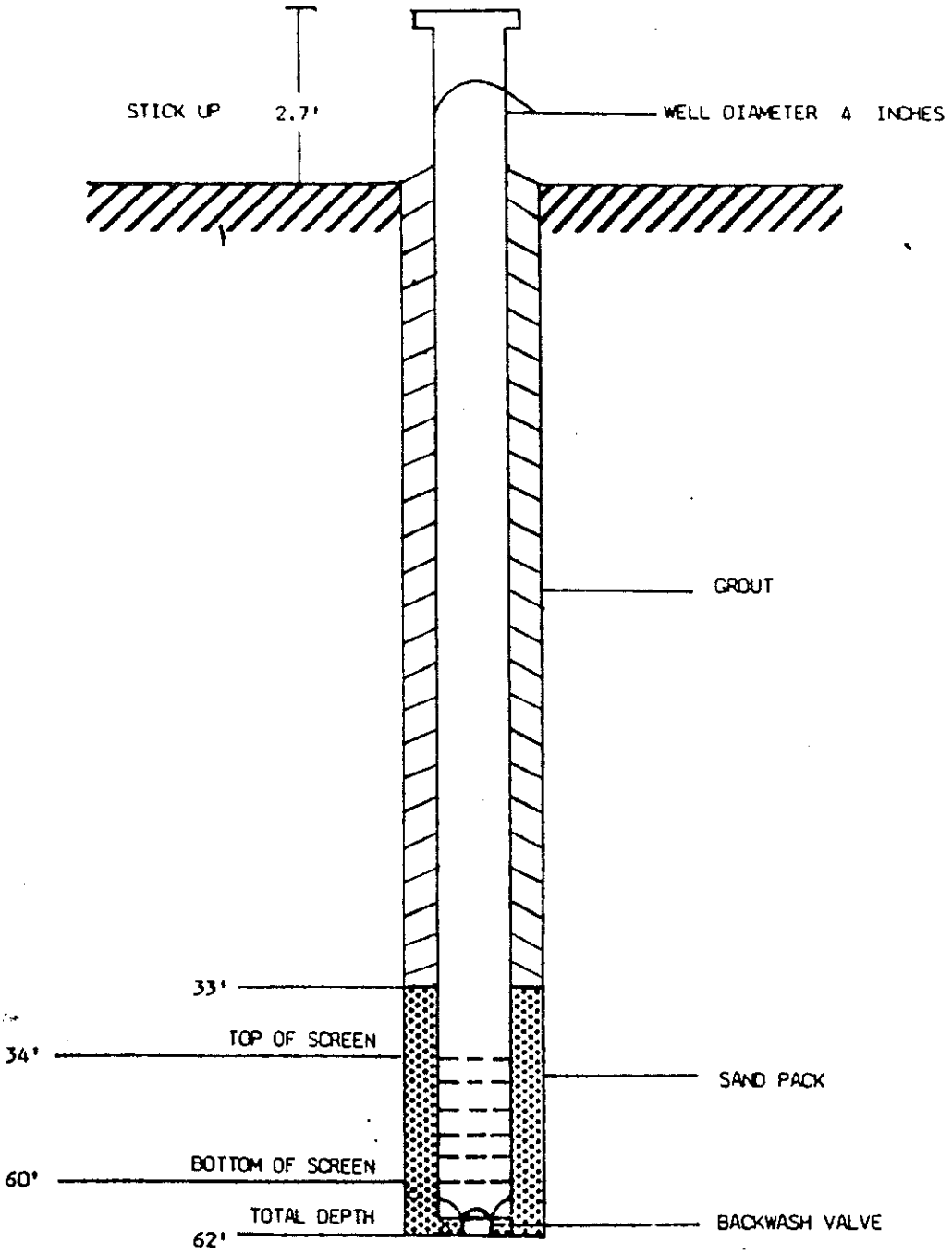
WELL INSTALLATION DETAIL

WELL NO. 6

THE DENKA CHEMICAL CORPORATION

[Installed by Espey, Huston & Assoc., Inc]

NO.	DATE DRILLED	EXHIBIT NUMBER
003	10/19/81	



CASING TYPE: Schedule 40 PVC (glued)

SCREEN TYPE: 0.010" Slotted Schedule 40 PVC

GROUT TYPE: Mortar Mix

NOTE: This exhibit is prepared from information provided on boring logs prepared by Espey, Huston & Associates, Inc. - 1981.

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Geotechnical Engineering & Groundwater Hydrology

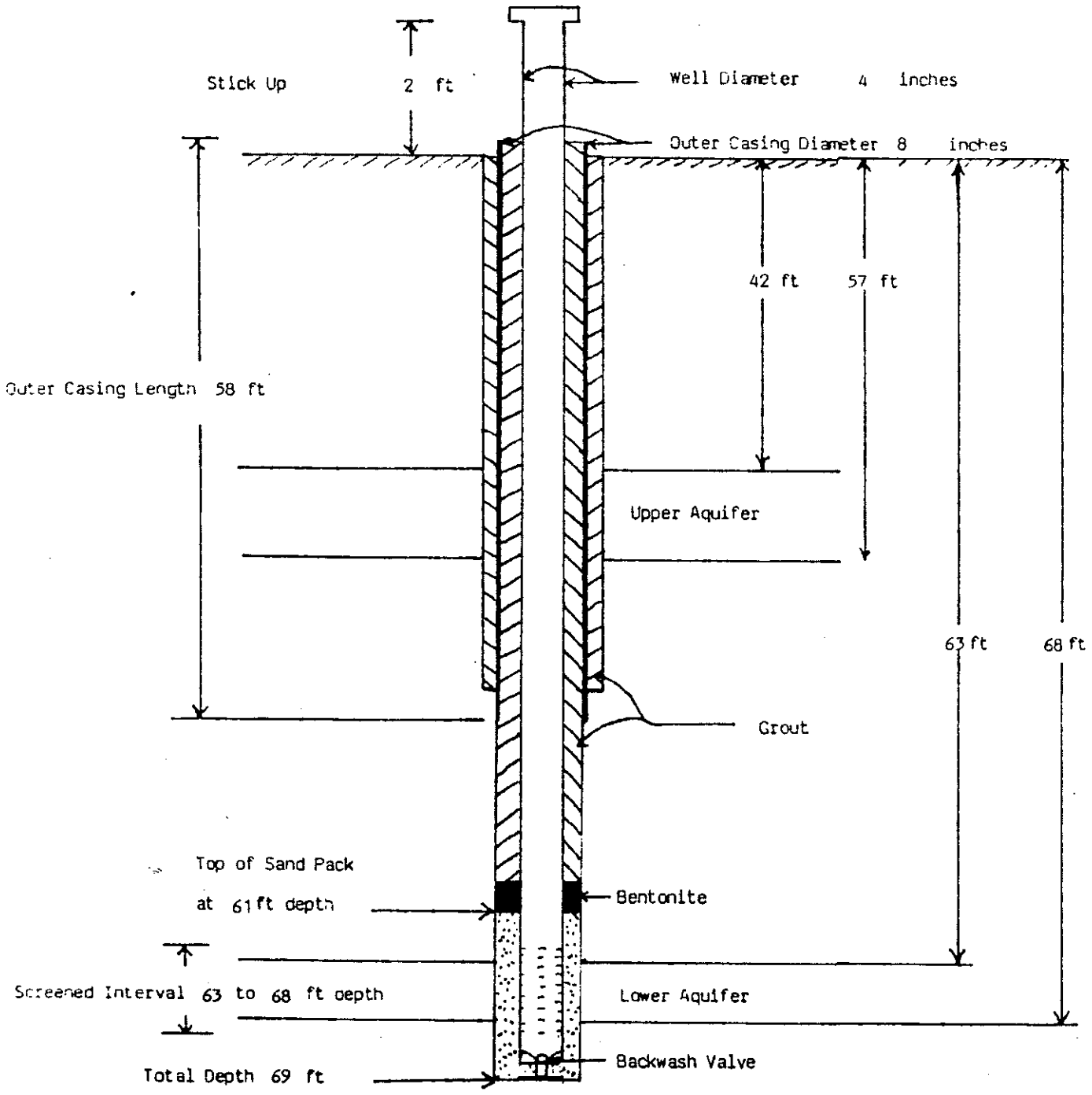
WELL INSTALLATION DETAIL

WELL NO. 7

THE DENKA CHEMICAL CORPORATION

[Installed by Espey, Huston & Assoc., Inc]

NO.	DATE DRILLED	EXHIBIT NUMBER
003	10/16/81	



Screen Type: .010" Slotted PVC Schedule 40

Grout Type: Cement/Bentonite

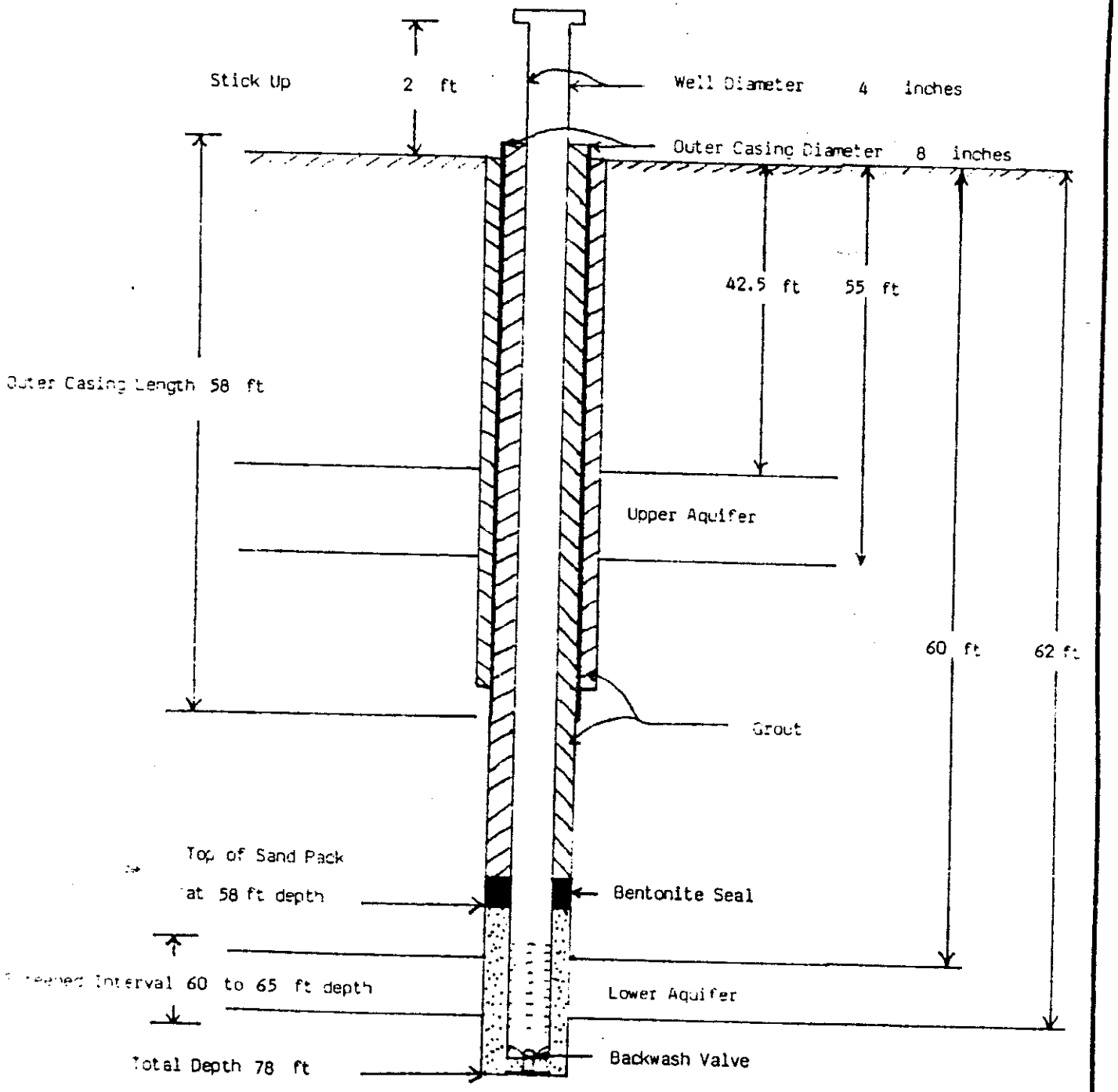
GEO ASSOCIATES

Geotechnical Engineering & Groundwater Hydrology

WELL INSTALLATION DETAILS
WELL 21

Denka Chemical Corporation - Houston Plant

NO.	DATE DRILLED	EXHIBIT NUMBER
003	9/15/83	



Screen Type: .010" Slotted PVC Schedule 40

Grout Type: Cement/Bentonite

NOTE: Lower portion of borehole (63'-78') was backfilled with bentonite pellets dropped through a tremie pipe.

GEO ASSOCIATES

Geotechnical Engineering & Groundwater Hydrology

WELL INSTALLATION DETAILS
WELL 22

Denka Chemical Corporation - Houston Plant

NO.	DATE DRILLED	EXHIBIT NUMBER
003	10/5/83	

Attachment A-6a
Well Data Summary

Well Number	Top of Pipe Elevation	Ground Elevation	Total Depth	Screen Depth Top	Screen Depth Bottom	Date Install
1	16.6	14.6	13.9	6.3	2.3	10-1
2	16.1	14.1	17.0	3.5	-2.5	10-2
3	22.1	20.1	18.0	8.2	5.2	10-1
4	28.5	25.0	28.0	8.0	-2.0	10-2
5A	19.2	17.2	41.0	-18.0	-24.0	2-1
21	22.8	20.8	69.0	-40.2	-45.2	9-1
22	17.4	15.4	78.0	-42.6	-47.6	10-
6	25.7		20.0	8.0	4.0	10-1
7	27.0		62.0	-9.6	-35.6	10-1
8	20.8			5.3	0.3	

Note: All elevations and depths are in feet above MSL.
Top of pipe elevation is about 2 feet above ground surface elevation except for Well 4 which is 3.5 feet above ground surface.

Attachment A-6b. Table of Well Construction Details

Well Number	1	2	3	4	5A	6	7	21
Hole diameter	4"	4"	4"	4"	4"	4"	4"	
Total depth	13.9	17'	18'	28'	41'	20'	62'	69'
Drill method								
Date drilled	10/19/81	10/21/81	10/19/81	10/20/81	2/11/82	10/19/81	10/16/81	9/15/83
Casing I.D.								4"
Casing type	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	
How joined	glued	glued	glued	glued	glued	glued	glued	glued couplings
Stick-up length	2.34'	1.62'	1.84'	3.5'	2.17'	2.7'	2.7'	2"
T.O.C.-MSL	16.6'	16.14'	22.08'	28.47'	19.15'			
Ground level-MSL	14.26'	14.52'	20.24'	24.97'	16.98'			
Capped/Lockable	Capped	capped	capped	capped	capped	capped	capped	capped
Surface pad size	none	none	none	none	none	none	none	none
Depth of surface seal								
Annulus Fill	cement grouted	cement grouted	cement grouted	cement grouted	cement grouted	cement/ bentonite		cement/ bentonite
Depth-annulus seal								
Depth-gravel pack	7'	10'	11'	16'	34'	14'	33'	61'
Length-gravel pack	6.9'	7'	7'	12'	7'	6'	29'	8'
Size-gravel pack								
Depth to screen	8'	11'	12'	17'	35'			63'
Screen I.D./slot	0.010"	0.010"	0.010"	0.010"	0.010"	0.010"	0.010"	4"/.010"
Screen type	slotted Schedule 40 PVC	slotted Schedule 40 PVC	slotted Schedule 40 PVC	slotted Schedule 40 PVC	slotted Schedule 40 PVC	slotted Schedule 40 PVC	slotted Schedule 40 PVC	Schedule 40 PVC
Screen length	4'	6'	3'	10'	6'	4'	26'	5'
Blank length								
Development Method								compressed air

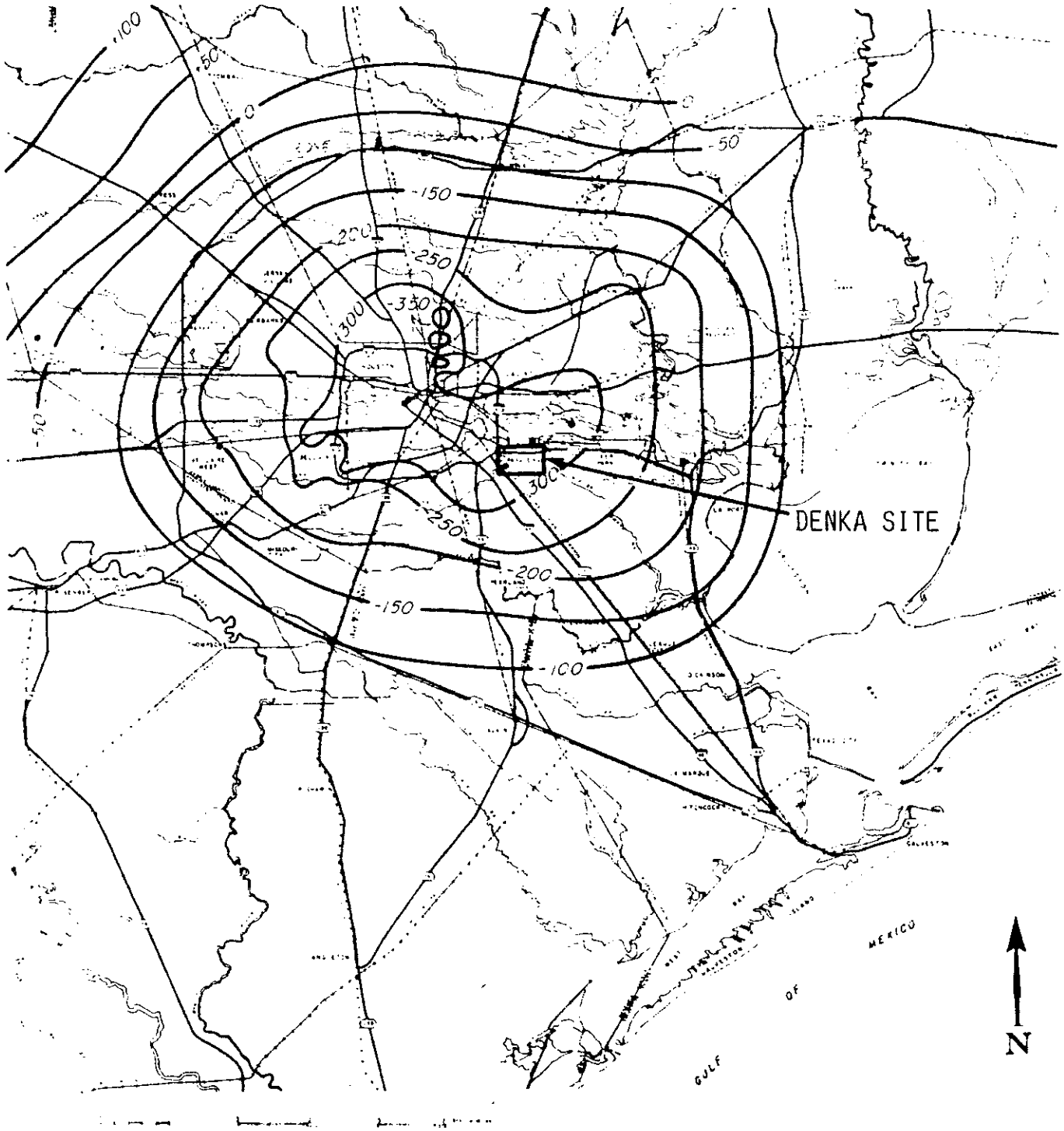
Comments:

Attachment A-6b. continued Table of Well Construction Details

Well Number	22							
Hole diameter	4"							
Total depth	78'							
Drill method								
Date drilled	10/5/83							
Casing I.D.	4"							
Casing type								
How joined	glued couplings							
Stick-up length	2"							
T.O.C.-MSL								
Ground level-MSL								
Capped/Lockable	capped							
Surface pad size	none							
Depth of surface seal	58'							
Annulus Fill	cement/ bentonite							
Depth-annulus seal								
Depth-gravel pack	58'							
Length-gravel pack	20'							
Size-gravel pack								
Depth to screen	60'							
Screen I.D./slot	4"/.010"							
Screen type	schedule 40 PVC							
Screen length	5'							
Blank length								
Development Method	compressed air							

Comments:

Attachment A-7



EXPLANATION

—200— POTENTIOMETRIC SURFACE CONTOUR, FEET ABOVE (+) OR BELOW (-) SEA LEVEL

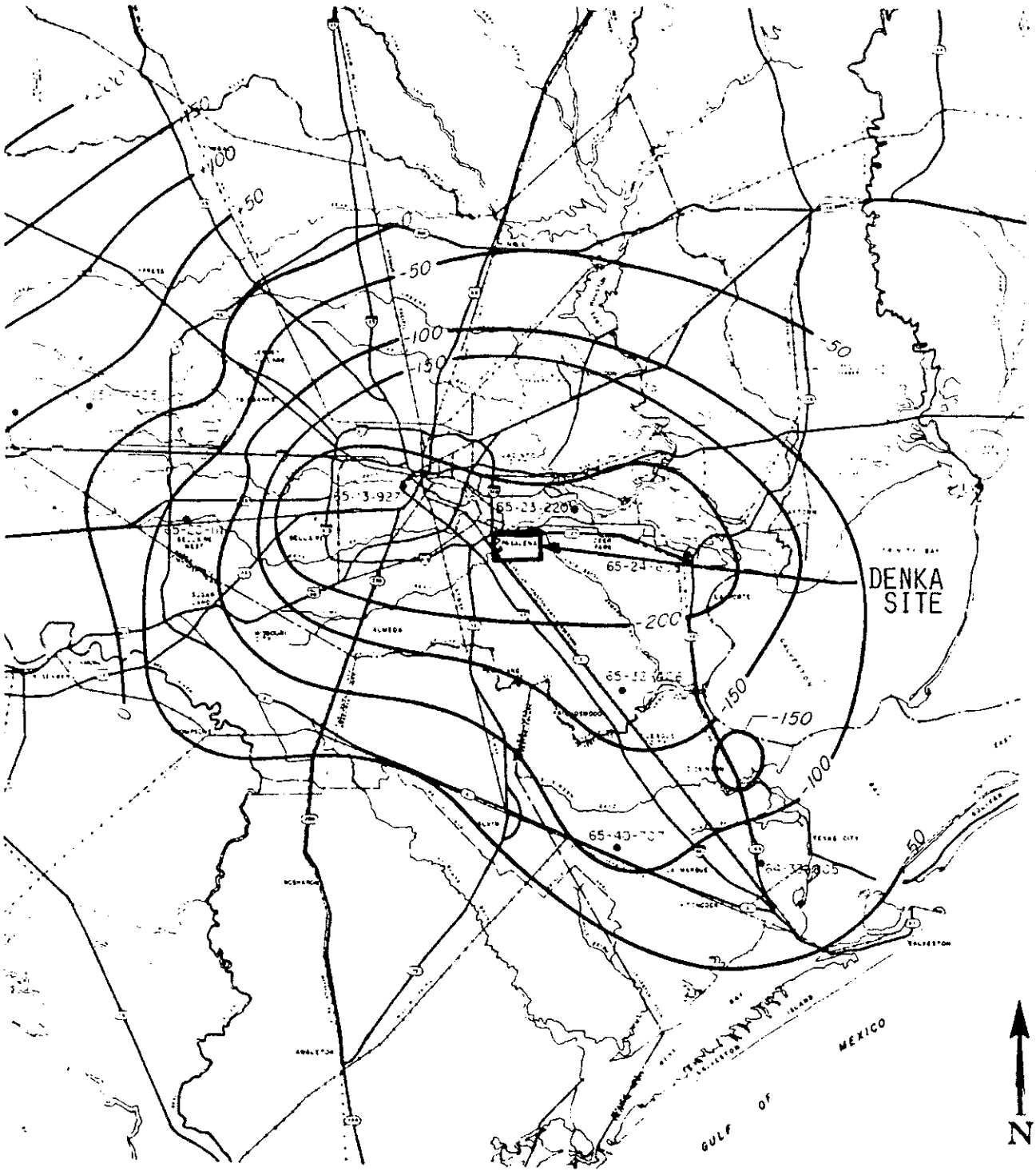
GEO ASSOCIATES

Geotechnical Engineering & Groundwater Hydrology

ALTITUDE OF POTENTIOMETRIC SURFACE
OF EVANGELINE AQUIFER Spring 1978

[adapted from: HGCSD Water Resource Management Program - Phase I]

NO.	DATE	EXHIBIT NUMBER
003	February 1985	13



EXPLANATION

—200— POTENTIOMETRIC SURFACE CONTOUR, FEET ABOVE (+) OR BELOW (-) SEA LEVEL

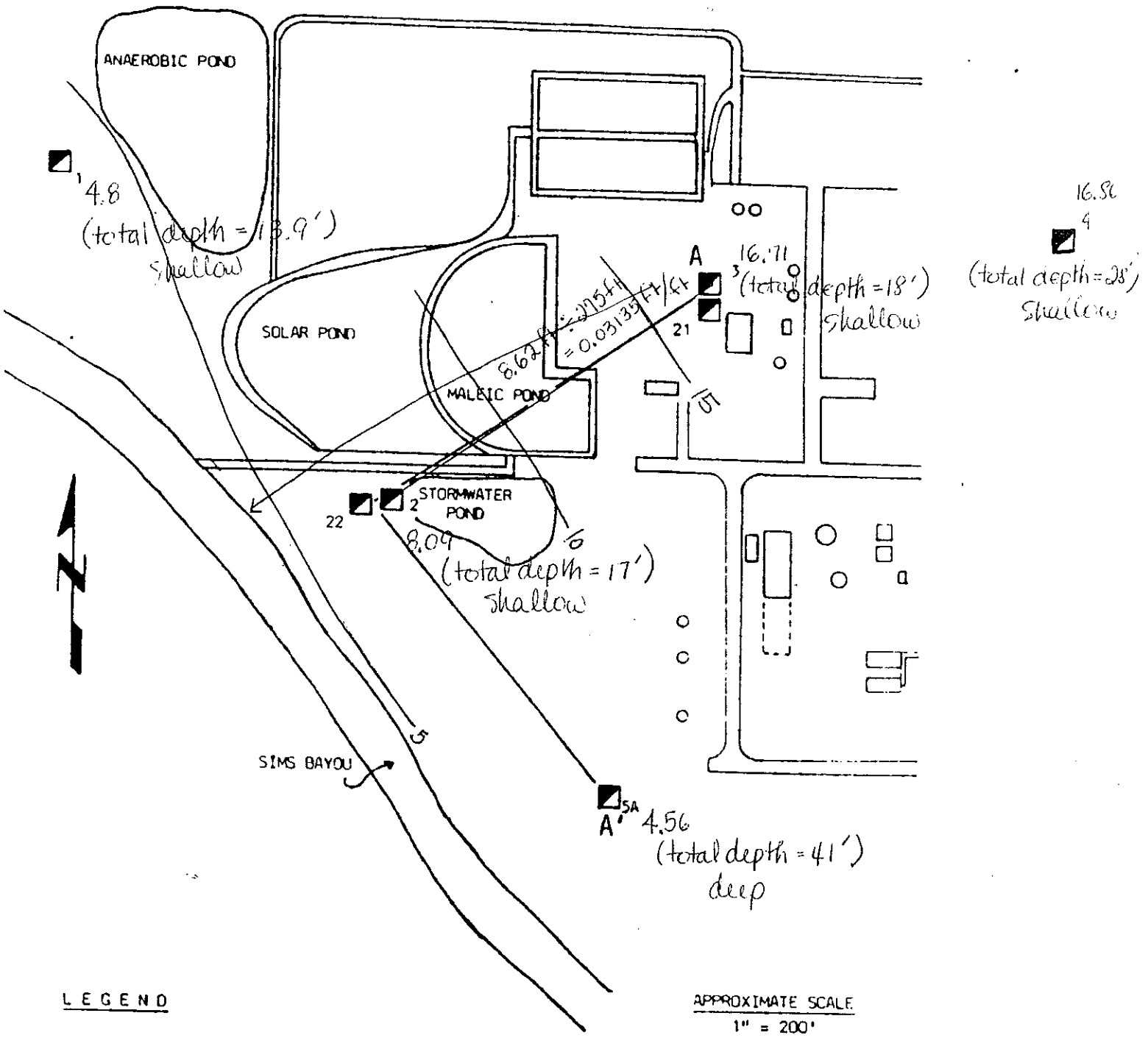
GEO ASSOCIATES

Geotechnical Engineering & Groundwater Hydrology

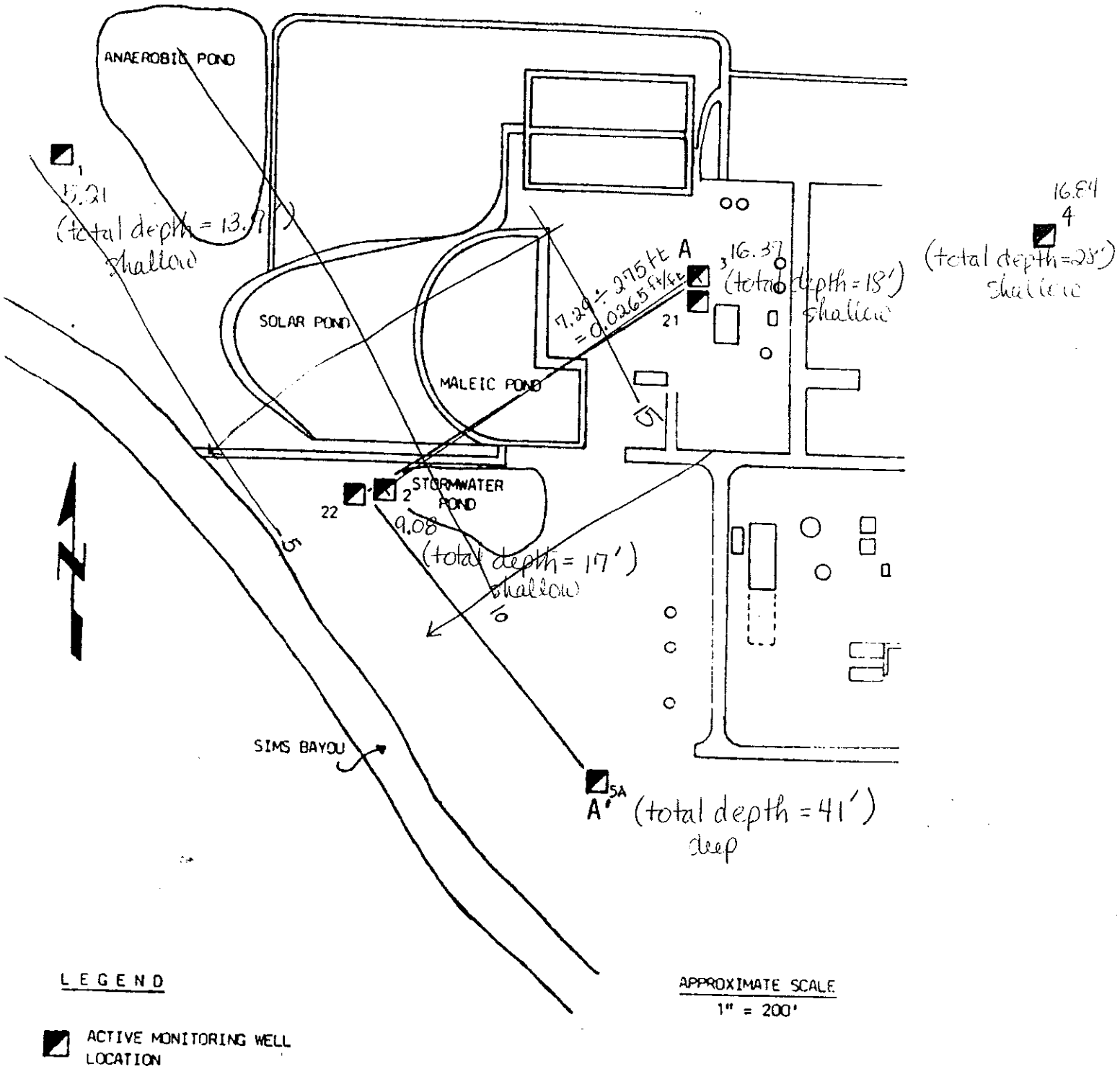
ALTITUDE OF POTENTIOMETRIC SURFACE OF CHICOT AQUIFER Spring 1978

[adapted from: HGCSD Water Resource Management Program-Phase I]

NO.	DATE	EXHIBIT NUMBER
003	February 1985	12

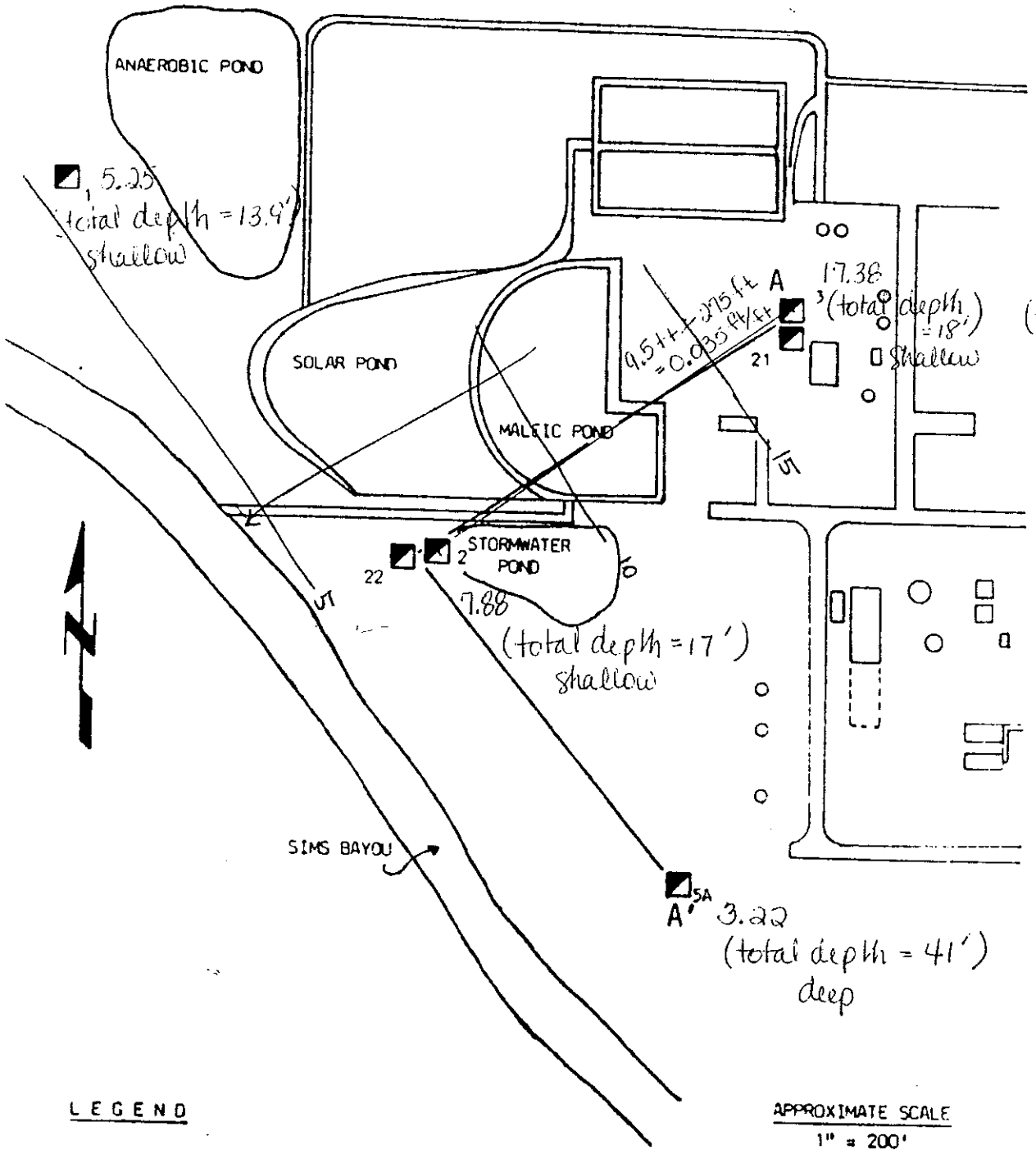


Water Level Measurements
for 2-18-82
Denka Chemical Corporation



Water Level Measurements
for 11-13-81

Denka Chemical Corporation



LEGEND

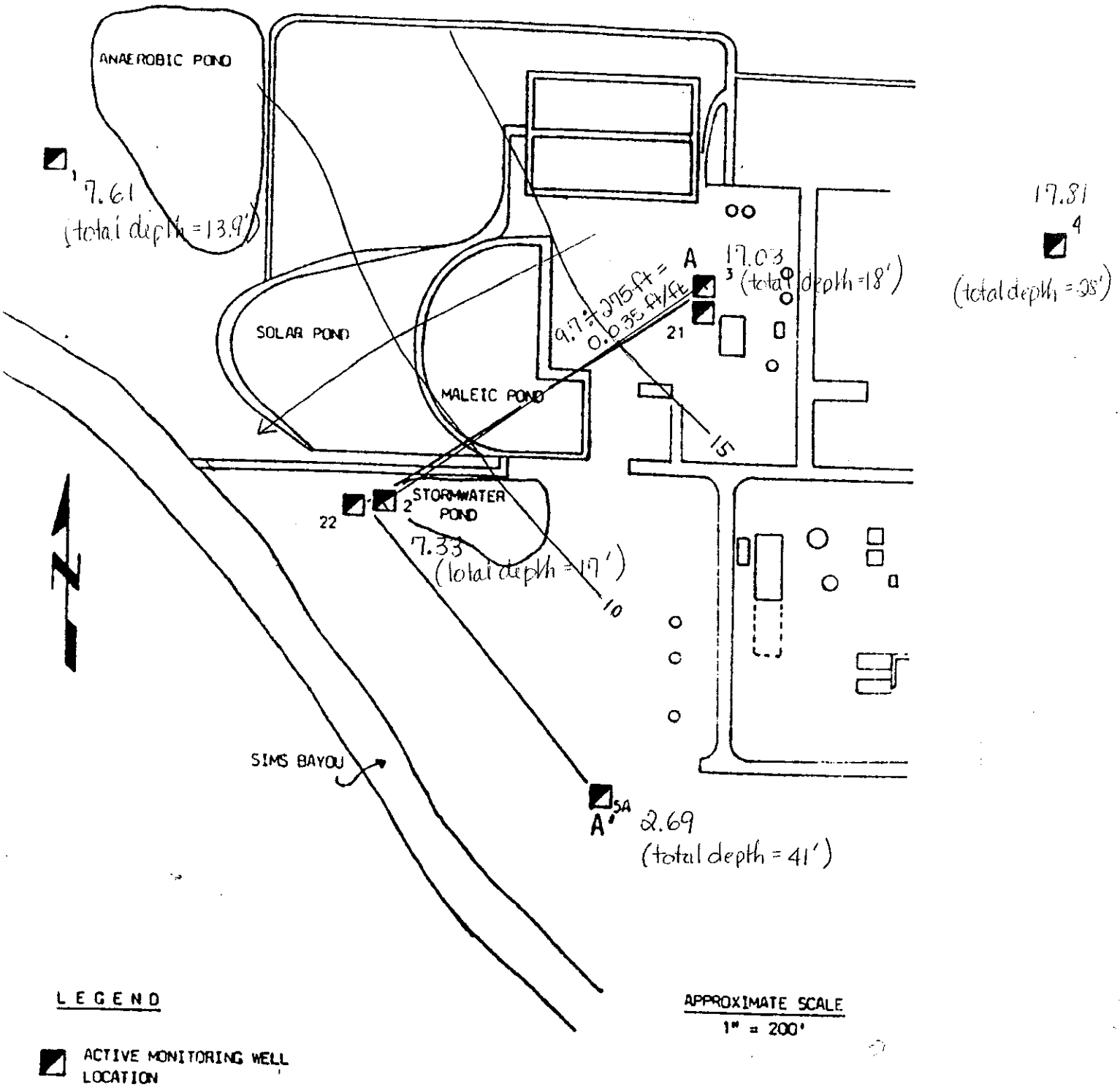
ACTIVE MONITORING WELL LOCATION

APPROXIMATE SCALE
1" = 200'

Water Level Measurements
for 5-10-82

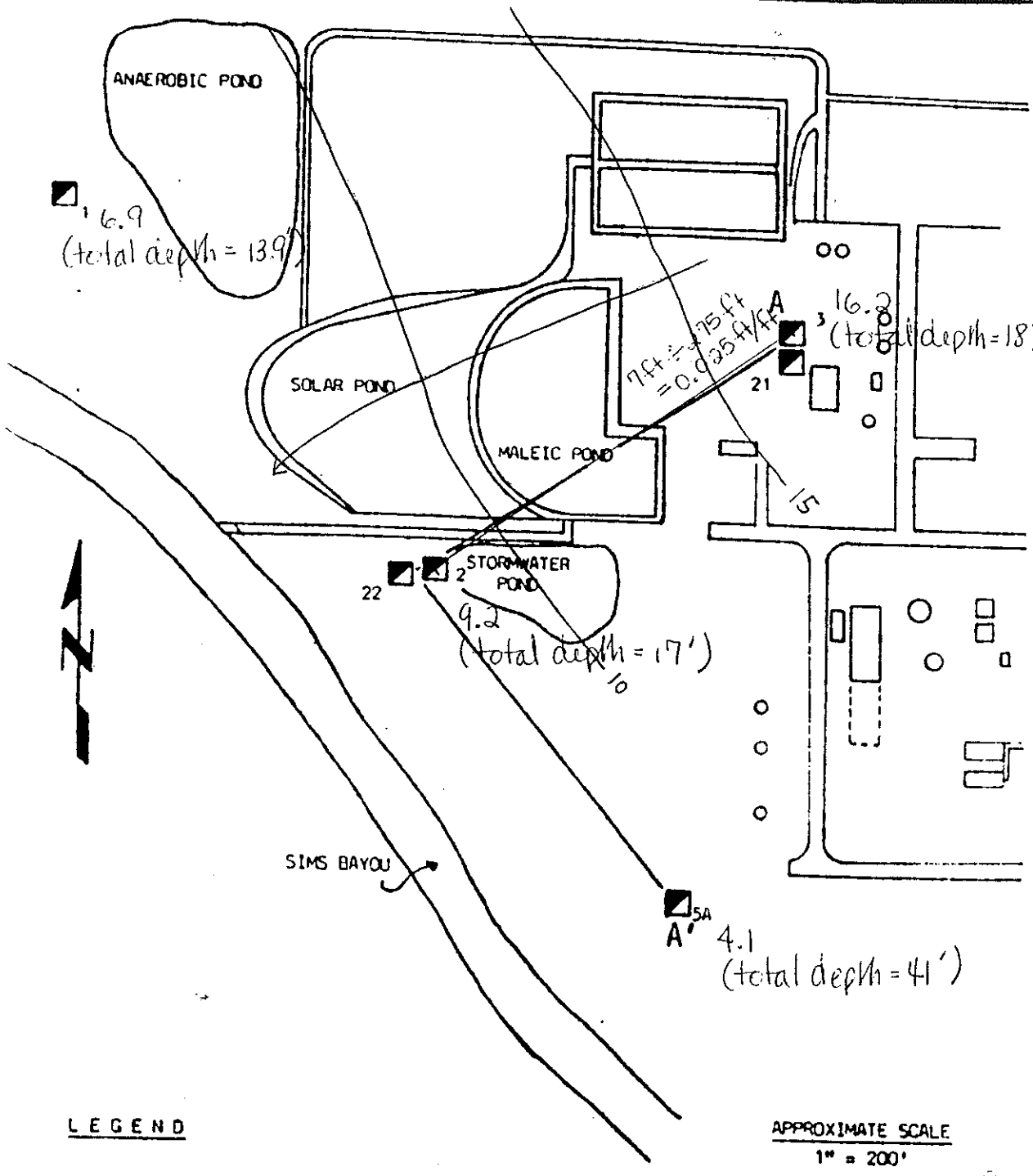
Denka Chemical Corporation

Note: Contour lines correlate to the shallow aquifer.



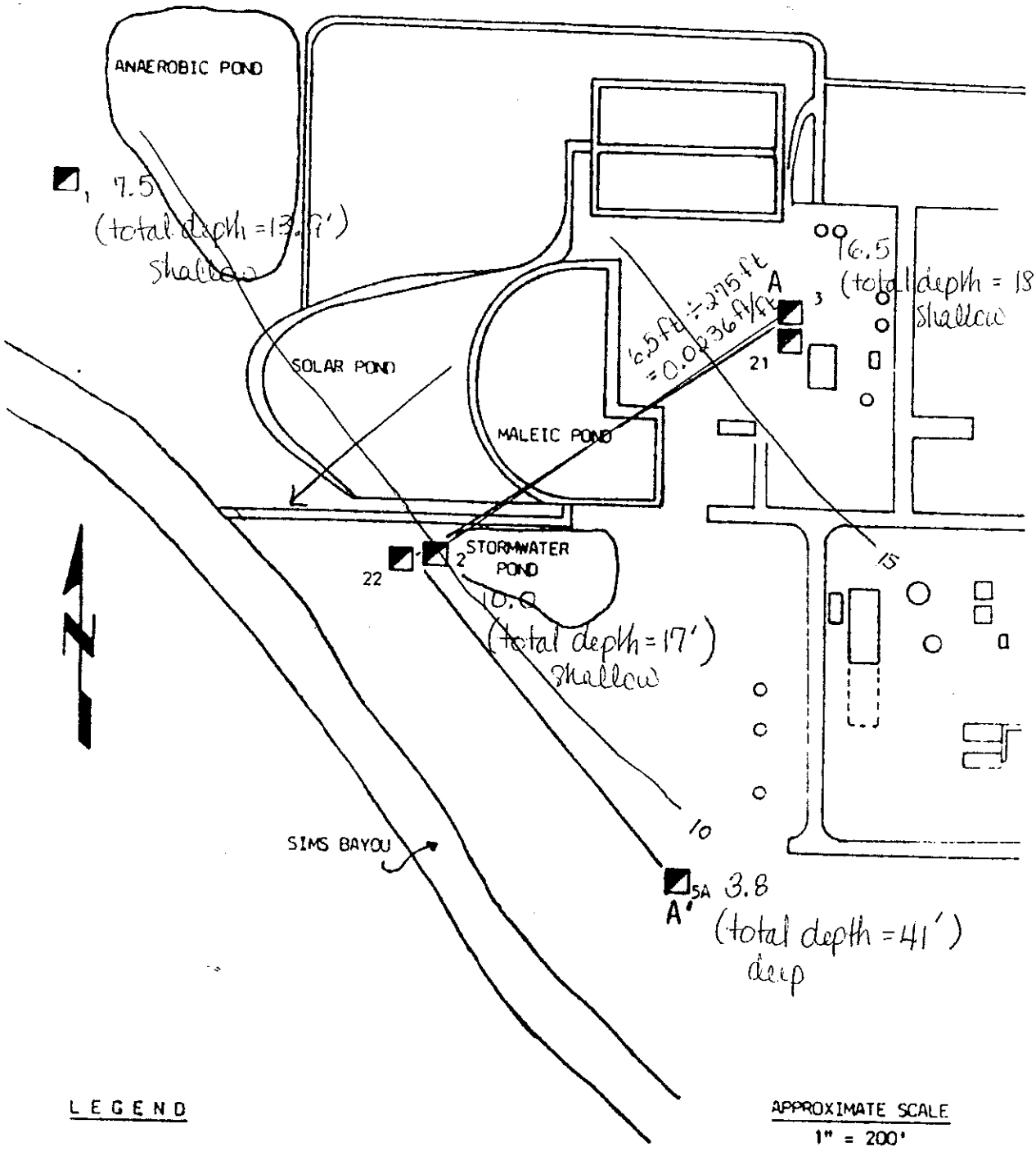
Water Level Measurements
for 8-12-82
Denka Chemical Corporation

Note: Contourlines correlate to the shallow aquifer.



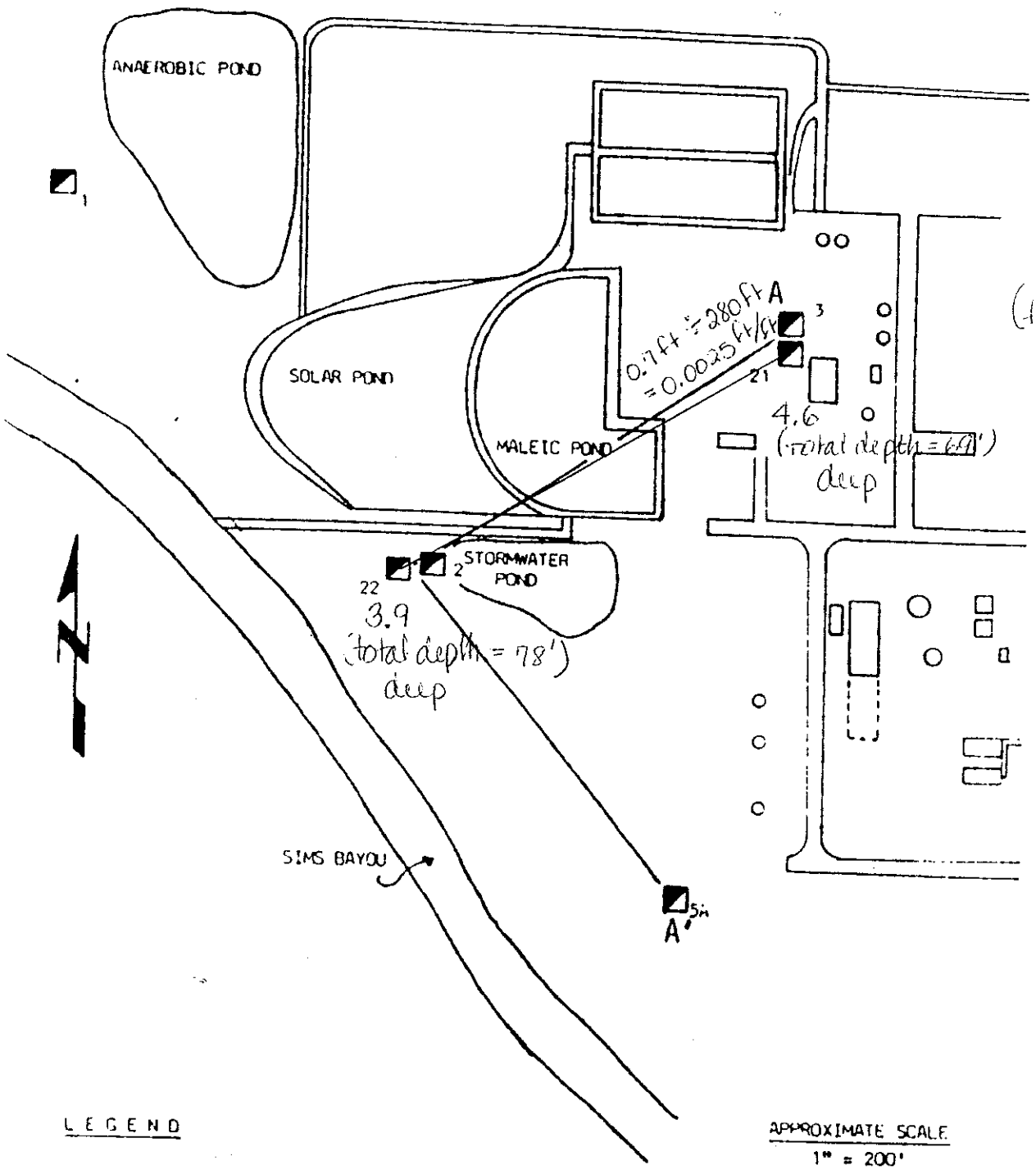
Water Level Measurements
for 5/83
Denka Chemical Corporation

Note: Contour lines correlate to the shallow aquifer.



* contours correlate to the shallow aquifer

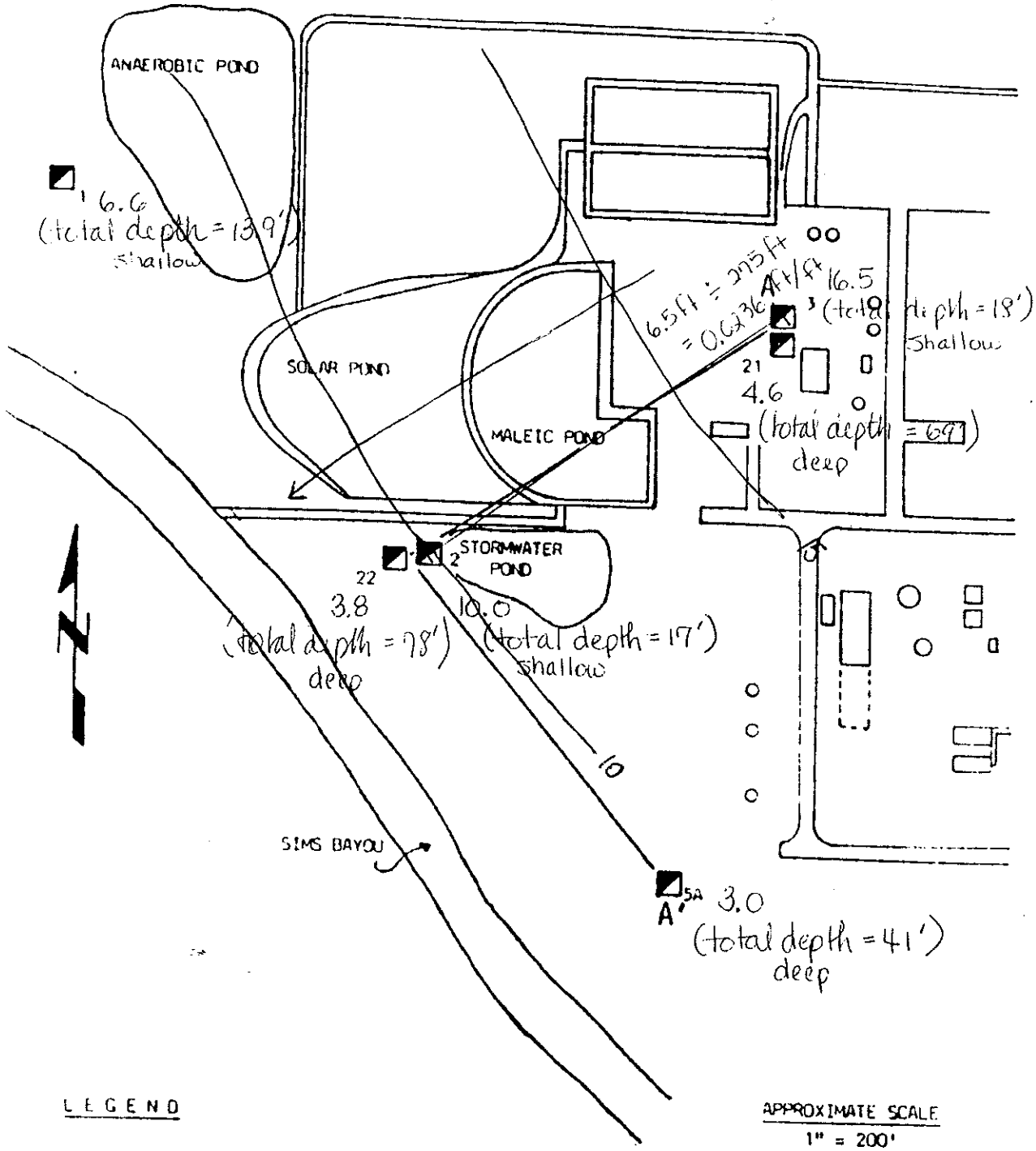
Water Level Measurements
for 6-83
Denka Chemical Corporation



Note: Calculations for gradients are for deep wells 21 and 22.

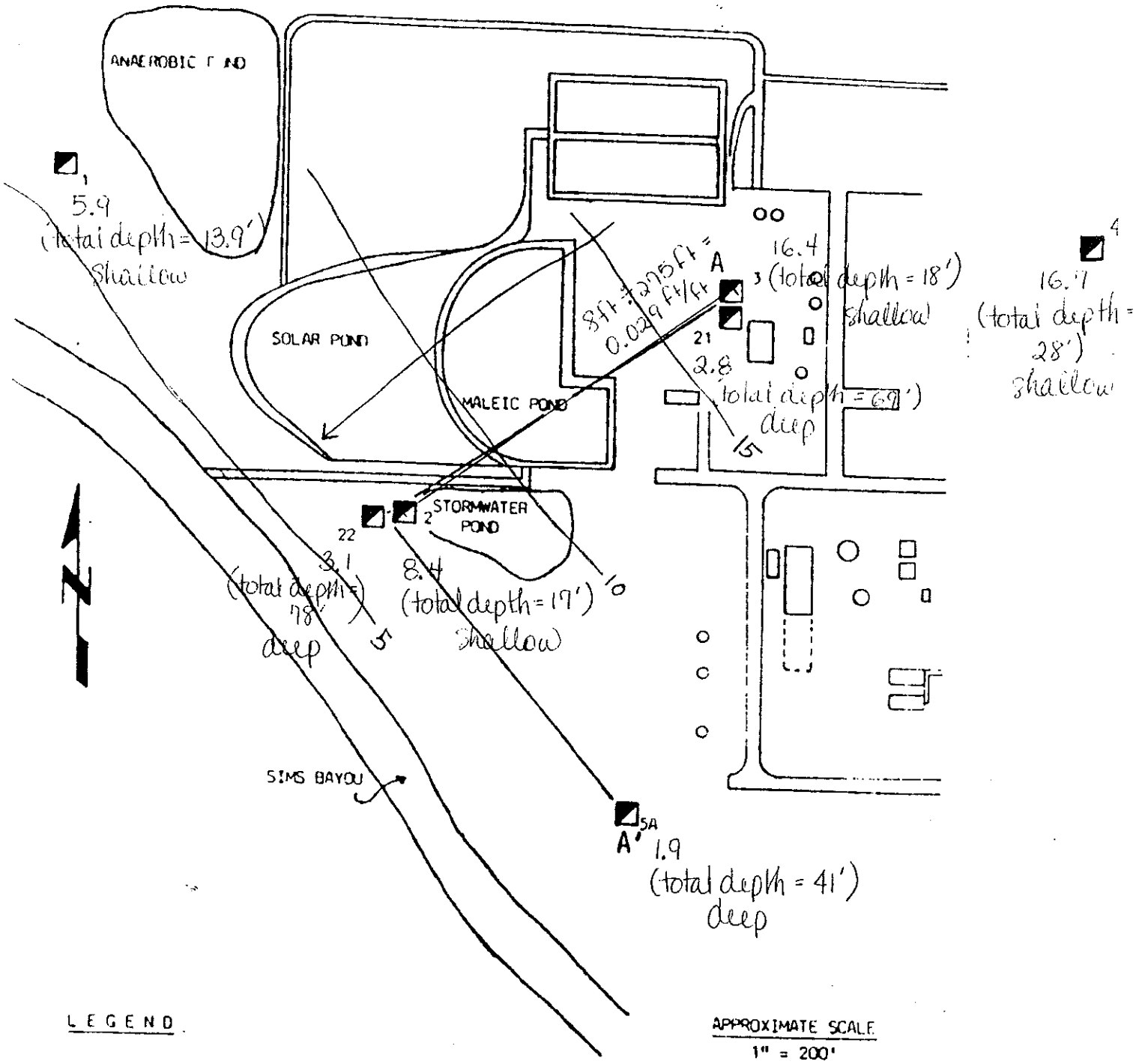
Water Level Measurements
for 10-83

Denka Chemical Corporation



Water Level Measurements
for 12-83
Denka Chemical Corporation

Note: Contour lines correlate to the shallow aquifer.



LEGEND

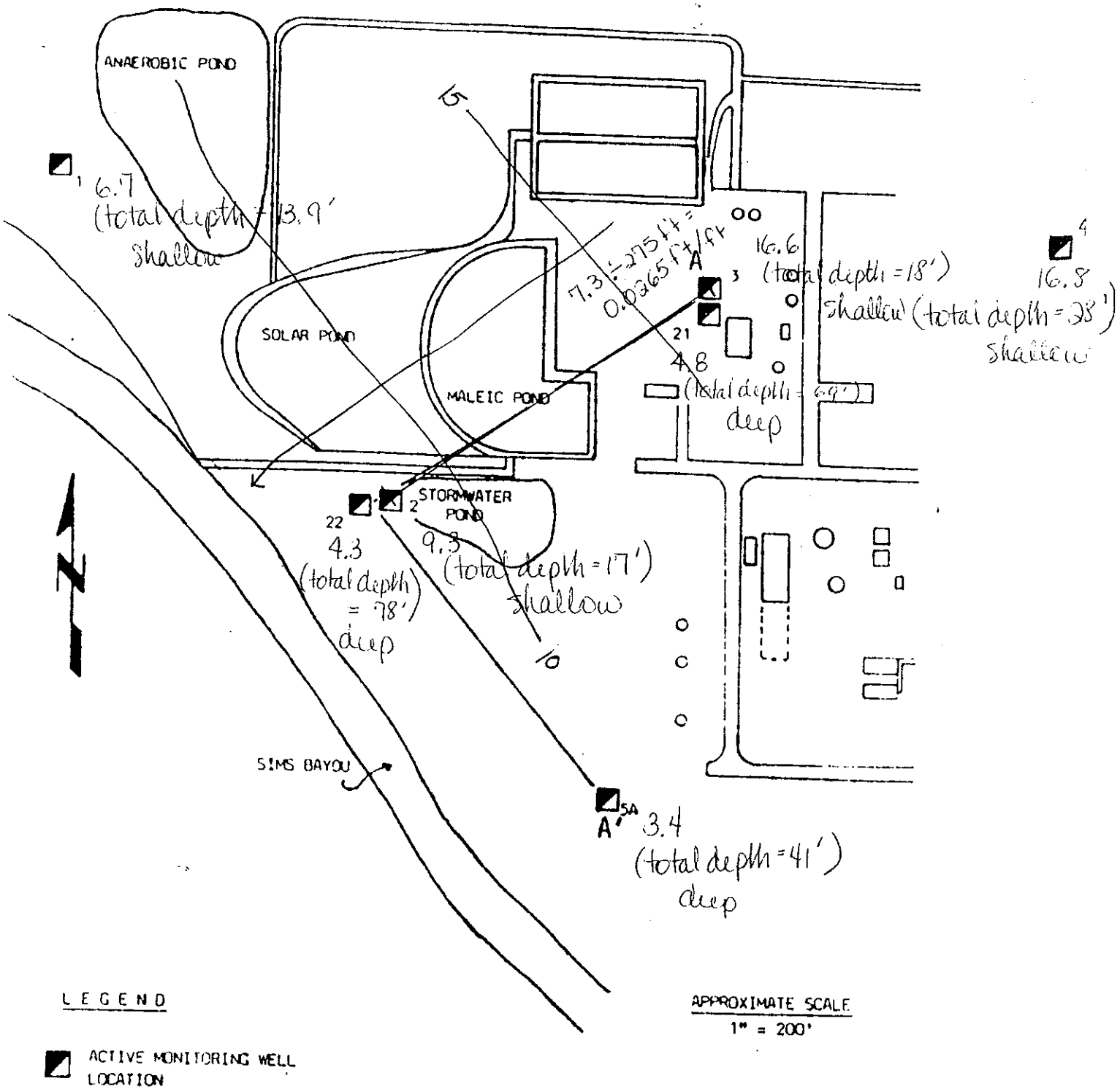
ACTIVE MONITORING WELL LOCATION

APPROXIMATE SCALE
1" = 200'

Water Level Measurements
for 3-84

Denka Chemical Corporation

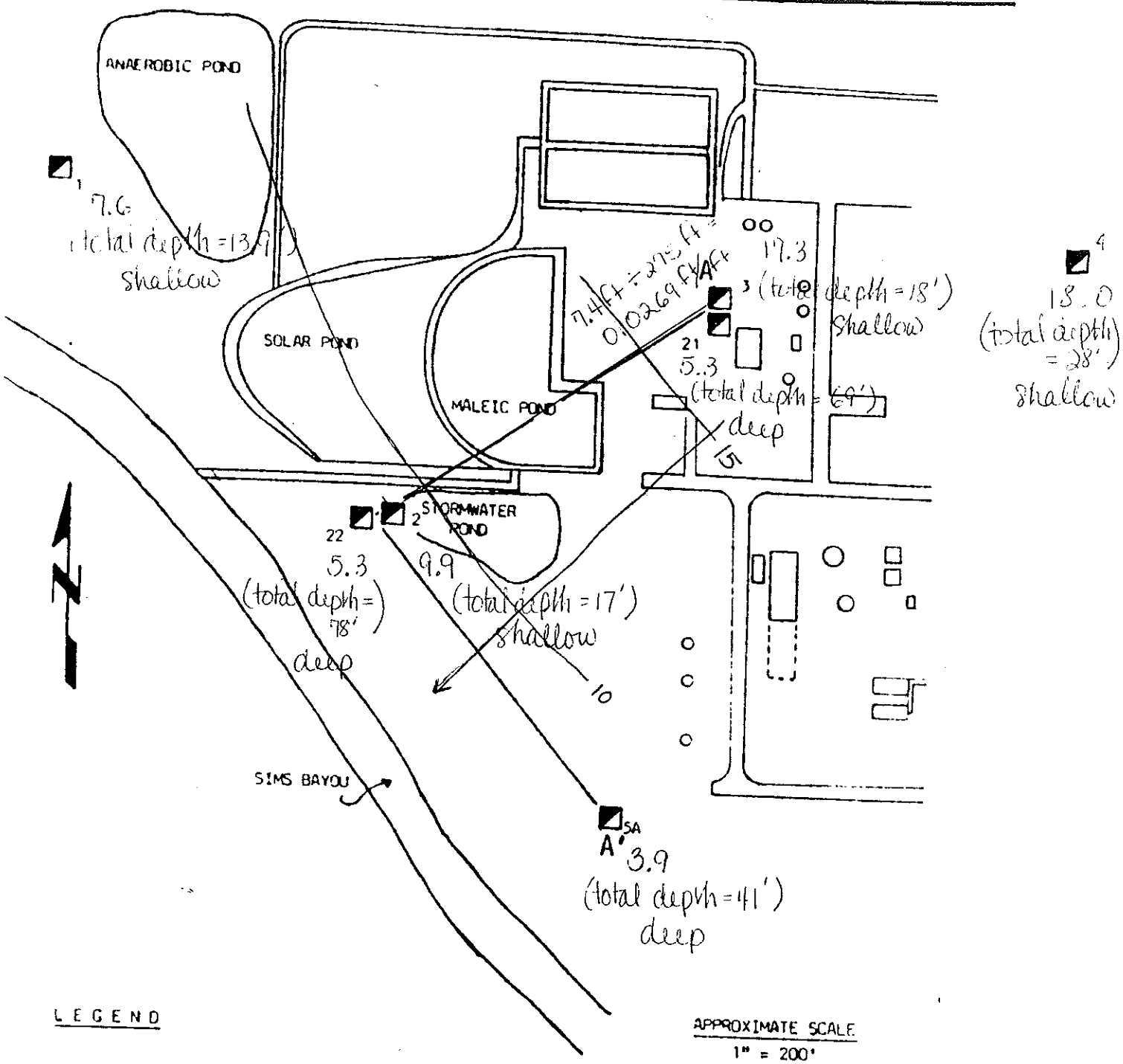
Note: Contour lines correlate to the shallow aquifer.



Water Level Measurements
for 6-84

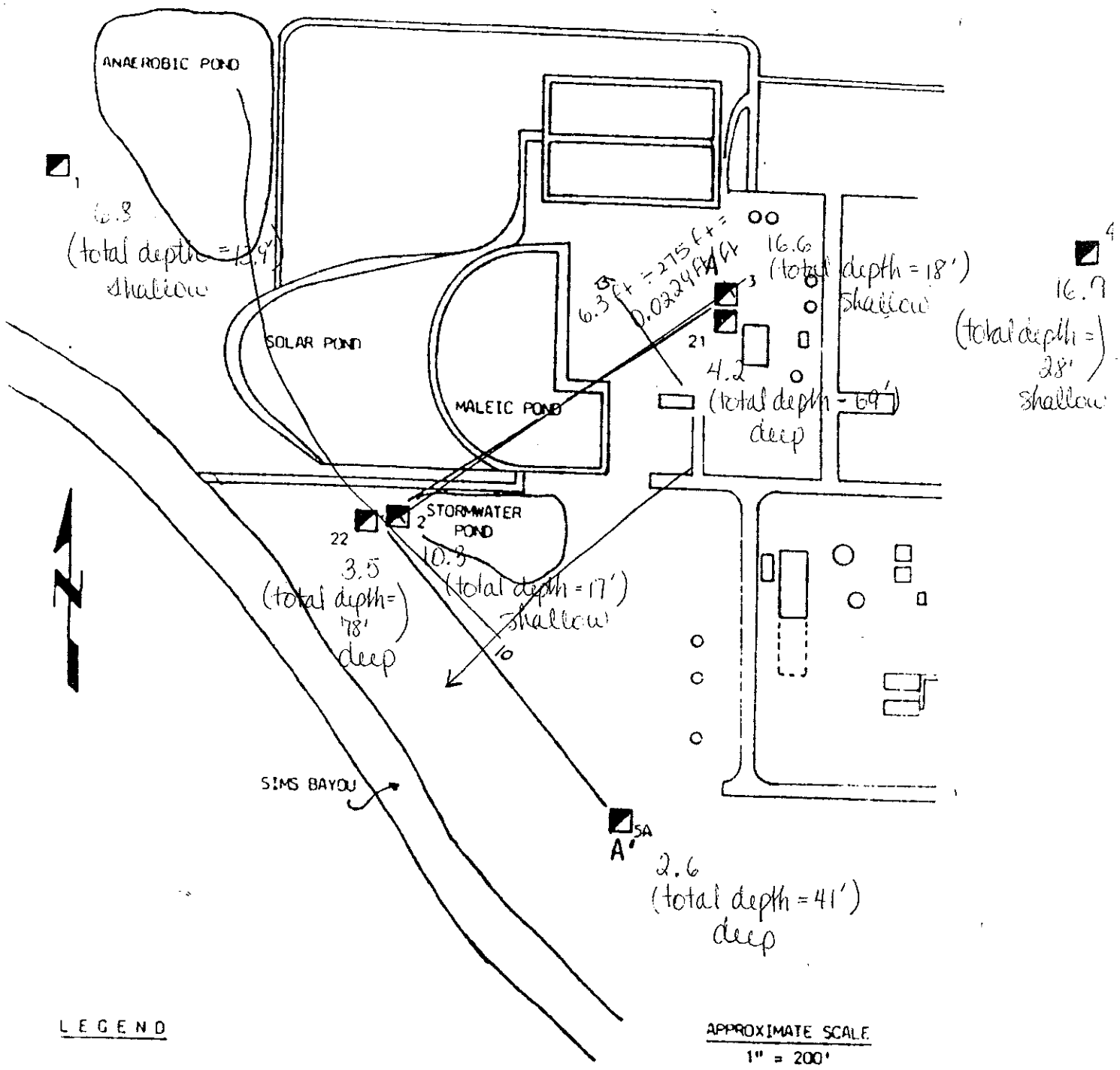
Denka Chemical Corporation

Note: Contour lines correlate to the shallow aquifer.



Water Level Measurements
for 11-84
Denka Chemical Corporation

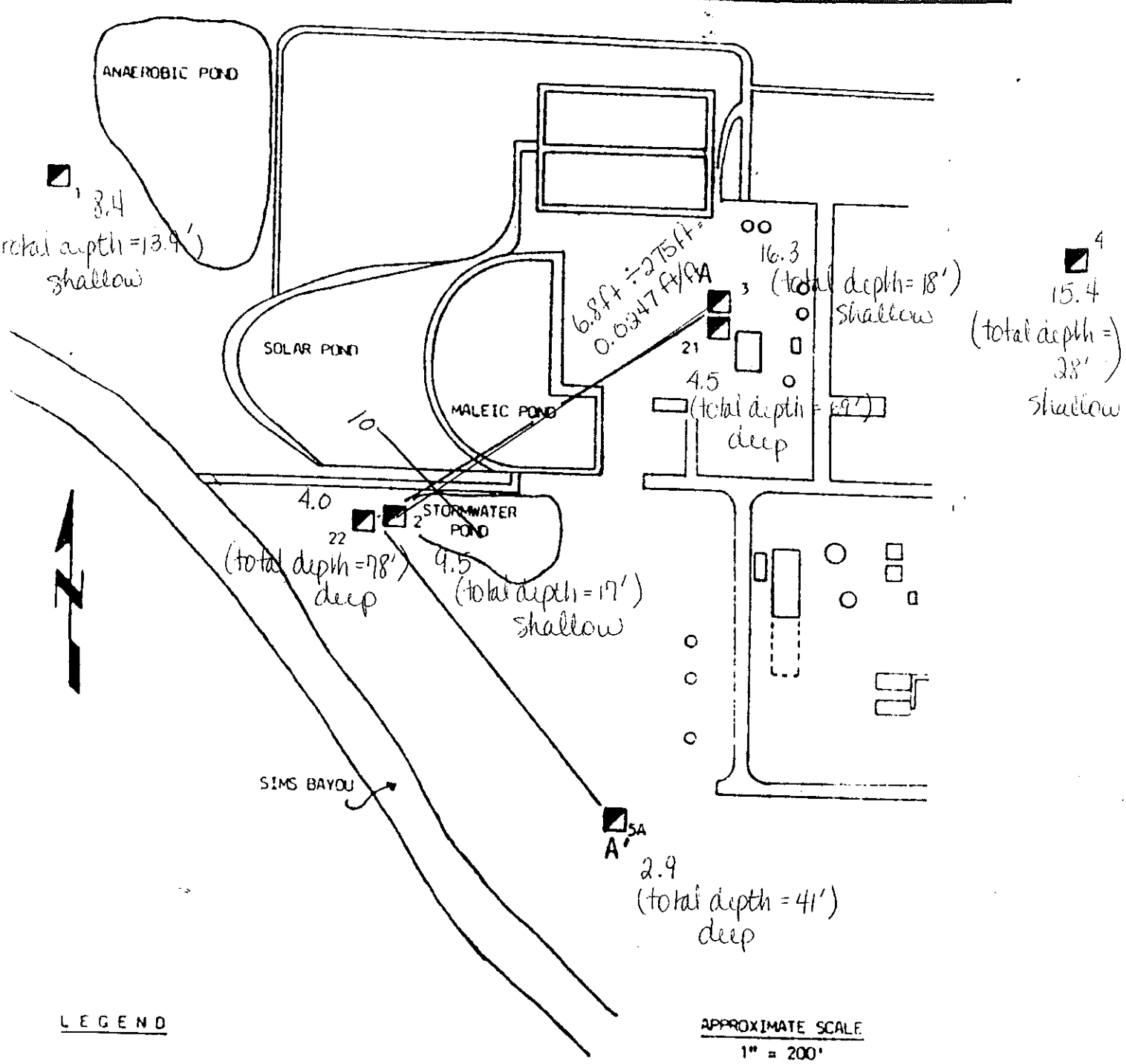
Note: Contour lines correlate to the shallow aquifer.



Note: Contour lines correlate to the shallow aquifer.

Water Level Measurements
for 1-85

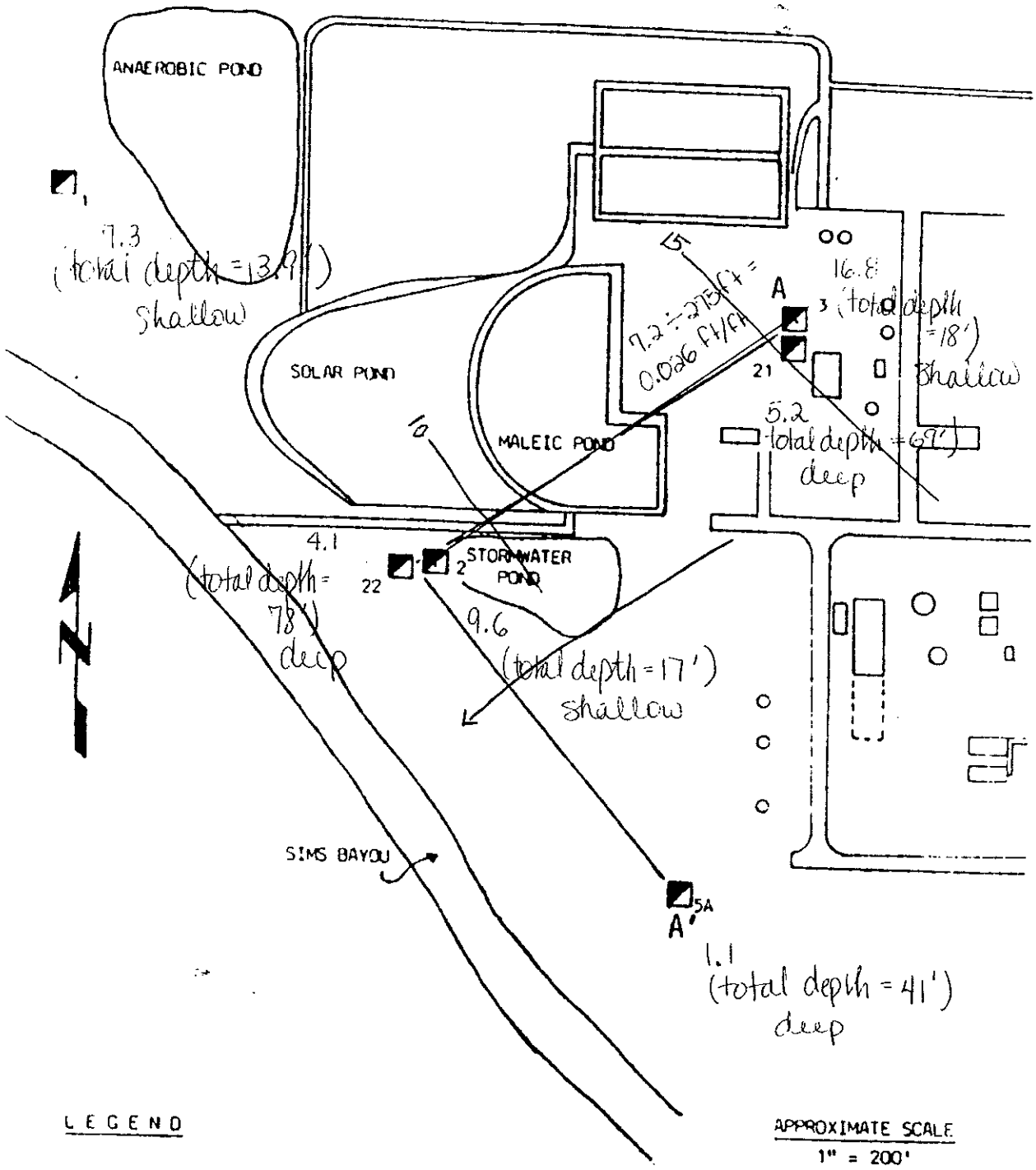
Denka Chemical Corporation



Note: Contour lines correlate to the shallow aquifer.

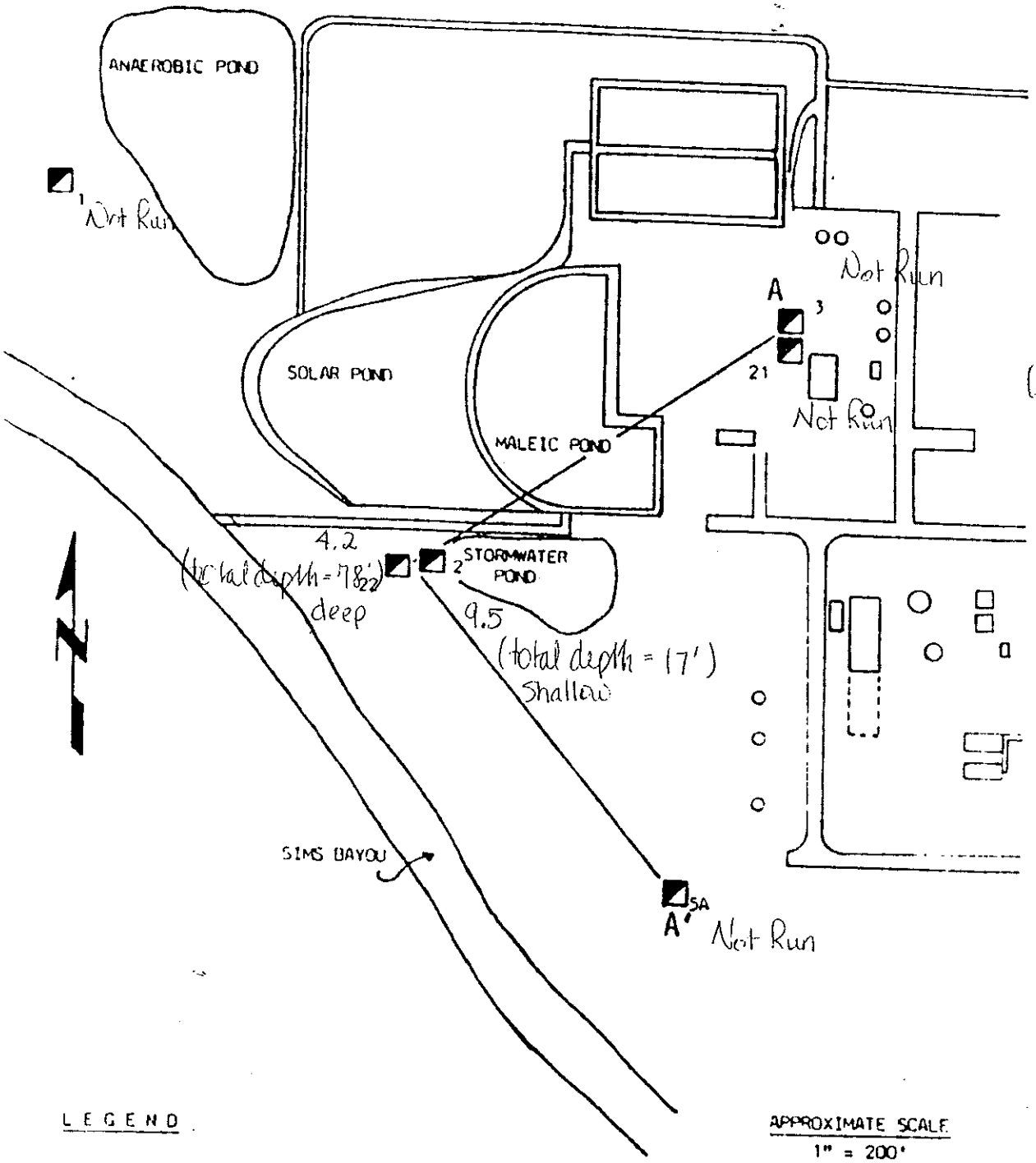
Water Level Measurements
for 4-85

Denka Chemical Corporation



Note: Contour lines correlate to the shallow aquifer.

Water Level Measurements
for 8-85
Denka Chemical Corporation



Water Level Measurements

for 9-85

Denka Chemical Corporation

$\bar{V} = \frac{Ki}{n}$

K = assume a permeability of 4.7×10^{-3} cm/sec which is 4,864.1 ft/yr

i = 0.035 ft/ft to 0.0229 ft/ft

n = assume porosity = 0.30

$\bar{V} = Ki/n$

$\bar{V} = \frac{(4,864.1 \text{ ft/yr})(0.035 \text{ ft/ft})}{0.30}$

$\bar{V} = 567.5$ ft/yr

and

$\bar{V} = Ki/n$

$\bar{V} = \frac{(4,864.1 \text{ ft/yr})(0.0229 \text{ Ft/ft})}{0.30}$

$\bar{V} = 371.3$ ft/yr

TEXAS WATER COMMISSION District No.
Estimates of Lateral Migration Rates Attachment A-8

D. Records and Response

1. Records - The Denka Chemical Corporation self reporting data does not appear to be complete. No self reporting data appears to be on record for the following sample events: 5/83, 6/83, 10/83, 12/83, 3/84 and 6/84. (The subject data is on file at the facility). In addition, Denka does not have complete Student T - test data on file with TWC or on file at the facility. Finally, Denka has not always been using the appropriate self-reporting forms, sometimes the data is submitted in tabular form.

2. Response

a. Chronology of Events:

June 5, 1981 - Denka notifies TDWR that piezometers are being installed to determine the groundwater hydrology at the site prior to the installation of monitoring wells.

January 21, 1982 - Denka submitted the first quarter groundwater monitoring data.

April 30, 1982 - Denka submitted the second quarter groundwater monitoring data.

July 26, 1982 - Denka submitted the third quarter groundwater monitoring data.

August 16, 1982 - Documentation for the Denka groundwater monitoring program was submitted (well logs, sampling procedures, monitor well locations, groundwater quality assessment plan, and monitor well location map).

September 28, 1982 - Denka submitted the fourth quarter groundwater monitoring data.

*December 14, 1982 - Denka requested a waiver from the groundwater monitoring requirements for the Denka/Petro Tex hazardous waste surface impoundments.

January 21, 1983 - Denka submitted a copy of the deed recordation for the upper maleic pond.

*May 17, 1983 - TDWR denied Denka's request for a waiver from the groundwater monitoring requirements.

July 15, 1983 - Denka notified TDWR that the initial sampling for the second year of groundwater monitoring showed a significant difference (as indicated by the Student's T-test) between the background and the current data. The company further notified TDWR that the facility may be affecting groundwater quality and that a ground water quality assessment program would be submitted within 15 days.

August 5, 1983 - Denka submitted a Ground Water Quality Assessment Plan.

September 9, 1983 - Meeting held between TDWR and Denka staff to discuss the Ground Water Quality Assessment Plan.

September 14, 1983 - TDWR approved Denka's Ground Water Quality Assessment Plan.

September 30, 1983 - Telephone conversation between TDWR staff concerning the status of the wastewater treatment system. It was concluded that the treatment system receives off-spec maleic anhydride (U147). The substance is occasionally put in a pond before going to the treatment plant. By the mixture rule, the treatment plant becomes a hazardous facility.

October 17, 1983 - TDWR requested Denka's Part B application.

November 18, 1983 - Denka met with TDWR to discuss what information is necessary to demonstrate that maleic anhydride and 1,4 dichlorobutene-2 are hydrolysed prior to entry into Petro-Tex's aeration basin.

May 18, 1984 - Meeting held with Denka staff to discuss the status of the assessment program.

May 29, 1984 - Denka submitted a Ground Water Quality Assessment Plan status report.

*June 29, 1984 - TDWR requested a groundwater compliance plan application from Denka.

*September 21, 1984 - Denka submitted the final report for the Groundwater Quality Assessment Plan.

December 14, 1984 - Denka submitted the first quarter groundwater monitoring data.

January 23, 1986 - Joint CEI and CME inspection at Denka.

February 25, 1986 - CME sampling event at Denka.

*Indicates copy of correspondence is attached in Attachment D-1.

b. Review of the Ground Water Quality

Denka Chemical Corporation initially reported on July 15, 1983 that the most recent data showed a statistically significant increase over initial background (Attachment D-2). Denka resampled the wells and on August 5, 1983 submitted a Ground Water Quality Assessment Plan (Attachment D-3). The agency reviewed said plan and recommended the following:

1. Schedule co-sampling of wells with District 7 personnel for the first quarterly sampling event.

2. Submit the results of the first quarterly sampling event for hazardus waste constituents, and

3. Submit a status report as soon as the results of the second quarterly sampling event are available (Attachment D-4).

Denka and Agency Staff met on May 18, 1983 (Attachment D-5) to discuss the status of the assessment program. A preliminary review of the data during the meeting indicated that most chlorinated hydrocarbons on the priority pollutant list were below detection limits. Mr. Lewis noted that the assessment would be more convincing with analyses for maleic acid and fumaric acid (the company claimed that there was no approved method of analysis for maleic and fumaric acid). Mr. Lewis further recommended that the company submit: (1) a status report within two weeks including analyses to date (2) proposed action for finding an analytical method for fumaric and maleic acid and (3) conclude the assessment by August 1984. Denka submitted an Interim Report on May 31, 1984 and a Groundwater Quality Assessment Plan Report of First Determination on September 19, 1984. The September report concluded the following:

1. The principal constituents of concern on the plant include maleic acid, fumaric acid, 3,4 dichlorobutene-1, 1,4 dichlorobutene-2, chloroprene, 1 chlorobutadiene, and xylene; however, none of these parameters have been detected in appreciable amounts by well sampling and GC/MS analyses. Well GWM-2 contained some benzene and toluene. Maleic acid, present in the pond, is not expected to be detectable at low concentrations by GC/MS and may be indicated in wells by lower pH and higher TOC values. These constituents have been observed and are believed to indicate possible minor seepage from the maleic pond system.

2. The stratigraphic and other data according to Denka indicates that the probable seepage from the maleic pond system is confined to the permeable zones shallower than the E1-45 ft. sand. Analyses from Well GWM-5A did suggest minimal ground water contamination.

3. Finally it was noted that some minor seepage from the maleic pond system enters Sims Bayou as a TOC component.

Two wells, GWM-21 and GWM-22, were installed under the Ground Water Quality Assessment Plan. The addition of these two wells brought the total number of wells in service to 7 (well nos. 1, 2, 3, 4, 5A, 21 and 22). The Denka facility has three other wells around the aeration ponds (well nos. 6, 7, and 8) however, to date no ground water monitoring data for these wells is on file with the TWC.

3. Recommendations

After reviewing the data it is the opinion of the inspector that the following items should be addressed by Denka:

1. All previous ground water monitoring data (not previously submitted on the appropriate forms) and all future ground water monitoring data should be submitted on the appropriate self-reporting forms. In addition, Denka has failed to submit past Student T-test calculations to the TWC. This T-test data should not only be submitted to the TWC but should be kept at the facility.

2. The logs from the existing wells at the facility should be submitted to the Commission. In addition, the total depth well of GWM-1 should be verified.

   Denka should provide to the Commission justification for the location and completion interval of the present monitoring well system or a proposal for installation of additional wells which will provide adequate detection of waste constituents in the uppermost aquifer. It appears that the horizontal spacing of the detection monitoring wells is too large. In general, detection monitoring wells should be spaced approximately 150 feet apart to guarantee that leaks will be detected if they occur.

4. The existing wells do not appear to be placed immediately adjacent to the waste areas (i.e., as close as physically possible, generally no more than thirty feet). Wells located far downgradient from the waste management area will not allow Denka to immediately detect contaminant leakage.

Attachment D-1

September 14, 1983

Lewis ____
Dixon ____
Schroeder ____

Mr. Robert E. Hinkson, Operations Manager
DENKA Chemical Corporation
8701 Park Place Boulevard
Houston, Texas 77017

Dear Mr. Hinkson:

Re: Ground Water Quality Assessment Plan - Solid Waste Registration 31052

The staff of the Solid Waste Compliance Unit has reviewed the ground water quality assessment plan submitted with your letter of August 5, 1983. We note that this plan meets the requirements of 31 Texas Administrative Code (TAC) Section 335.194(d)(3) and that it should be able to determine the concentration of hazardous wastes or constituents in the ground water and the rate and extent, both horizontally and vertically, of contaminant migration.

We concur with the assessment plan's proposed course of action. As discussed with Mr. Paul Lewis and Mr. Fred Dalbey during the September 9, 1983 meeting, please modify the schedule of implementation to include the following:

1. Schedule co-sampling of wells with District 7 personnel for the first quarterly sampling event (approximately September 30, 1983).

2. Make available to the Department the results of the first quarterly sampling event for hazardous waste constituents.

3. Submit a status report to the Department as soon as possible after the results of the second quarterly sampling event are available (approximately December 30, 1983). The report should include an evaluation of the sources of constituents in the monitor wells and, if needed, recommendations to modify the assessment plan.

Please feel free to contact Mr. Paul S. Lewis at 512/475-6371 if you have any questions.

Sincerely,

Gary D. Schroeder, P.E., Chief
Solid Waste and Spill Response Section
Enforcement and Field Operations Division

PSL:py

cc: Texas Department of Water Resources District 7 Office

TEXAS DEPARTMENT OF WATER RESOURCES
1700 N. Congress Avenue
Austin, Texas

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October 17, 1983

JW WEBB
EANES JGS STADLER
MESSENGER
SNOW

Robert E. Hinkson
Industrial Relations Manager
Denka Chemical Corporation
8701 Park Place Boulevard
Houston, Texas 77017

CERTIFIED MAIL

Dear Mr. Hinkson:

RE: Hazardous Waste Permit Application No. 10287
Solid Waste Registration No. 31052

The State of Texas hazardous waste permit program has been declared equivalent to the federal program by the U.S. Environmental Protection Agency. This "Phase II Interim Authorization" covers permitting of storage, processing and disposal facilities. Thus, duplicate federal permits for such facilities under the Resource Conservation and Recovery Act are no longer required in Texas. Therefore, the Texas Department of Water Resources (TDWR) is now implementing the hazardous waste permit program.

Our records indicate that you filed a state and/or federal Part A hazardous waste permit application indicating that you have an operational facility for storage, processing and/or disposal of hazardous waste. In accordance with Title 31 Texas Administrative Code (TAC) Section 341.180(4), we hereby request Part B of your application for a hazardous waste permit. Please find enclosed the TDWR Industrial Hazardous Waste Part B Permit Application form and instructions. Please note that the instructions cover the technical requirements of the application in detail, and are not to be submitted with the application.

Also, for your reference, please find enclosed a blank Part A application form. Please note that the enclosed Part A has been revised and that the numbering system, in some cases, does not correspond to the numbering system on the originally submitted Part A. For the Part A sections listed below, the numbers in parentheses refer to the original Part A. A review of the subject facility's Part A hazardous waste permit application indicates that insufficient information has been presented to demonstrate compliance with 31 TAC Section 341.180. These deficiencies are detailed below:

Section I. General Information:

Please note the signatures for the applicant are required in the appropriate place below the certifying statement.

I.G.2.:

The Standard Industrial Classification (SIC) code given for the production of maleic anhydride is incorrect.

Section II. Site Background Information:

II.A.5.a. & b.(II.A.6.a. & b.):

Submit as "Attachment B" a map indicating the boundaries of all adjacent parcels of land, and a list of the names and mailing addresses of all adjacent landowners and other nearby landowners who might consider themselves affected by the activities described by this application. Cross-reference this list to the map through the use of appropriate keying techniques. The map should be a USGS map, a city or county plat, or another map, sketch or drawing with a scale adequate enough to show the cross-referenced affected landowners. Indicate from what sources the names and addresses of persons identified as affected were obtained.

Please review this information to ensure that it is up-to-date.

Section III. Wastes and Waste Management:

III.A.2.:

The wastes listed in Table III-I, that are not currently contained in your notice of registration, have been added to your registration. Please use the appropriate TDNR sequence number, waste classification code, annual quantity generated (as close as possible) and SIC code.

III.B.1.:

Table III-2 should be revised to include TDNR waste sequence numbers.

III.B.3.:

Table III-4 should be revised to note the date the pond was actually closed, as opposed to deed recorded.

III.C.1.:

"Attachment E" should be revised to include:

a. The approximate boundaries of the site (described in Section II B) and within these boundaries, the location and boundaries of the areas occupied by each active, inactive, and proposed facility component (see Tables III-2 and III-3 for facility components). Each depicted area should be labeled to identify the facility component(s), component status (i.e., active, inactive, or proposed), and area size in acres.

b. All injection wells where liquids are injected underground;

c. All known monitor wells and boreholes within the property boundaries of the overall plant site; and

d. All wells, springs, other surface water bodies, and drinking water wells within the map area and the purpose for which each water well is used (e.g., domestic, livestock, agricultural, industrial, etc.).

In addition, it would appear that the wastewater treatment plant jointly owned by your company and Petro-tex Chemical Corporation (Reg. # 30417) remains a hazardous waste management unit. "Attachment G" of the referenced Part A states that off-spec maleic anhydride (U147) and 1, 4-dichloro-2-butene (U074) enter the wastewater system from the maleic pond or from the neoprene equalization tanks. These wastes are listed for toxicity. The influent to the treatment plant is a solid waste generated from the treatment of a hazardous waste listed under Subpart D of 40 CFR Part 261 and has not been delisted under 40 CFR Part 260.20 and 260.22. As Petro-tex Chemical Corporation is the plant operator and wastewater permit holder, the treatment plant will be addressed during their permitting process.

Please note that rinsates from "empty" drums which contained hazardous wastes are subject to regulation under RCRA, if the rinsate is a characteristic hazardous waste as defined under 40 CFR Part 261, Subpart C.

The Part B permit application and the aforementioned Part A requirements should be submitted by April 17, 1984. Please note that four copies of the Part A requirements, five copies of the entire Part B application, and four additional copies of Section I of Part B are required.

Please contact the Department as soon as possible, before submitting the Permit Application, if any of the following items apply:

1. Your company intends to close all hazardous waste management units before the application deadline;

2. Your company intends to pursue any type of waiver or exemption;

3. Your company intends to do liner compatibility testing (EPA Test Method 9090);

4. Your company intends to conduct field tests or laboratory analyses in conjunction with the treatment demonstration required for land treatment units;

5. A review of the ground-water monitoring data indicates that your company may need to follow a compliance monitoring or corrective action program;

6. Your company intends to demonstrate a need for alternate concentration limits to be used in the ground-water monitoring program; or

7. Your company intends to demonstrate that certain constituents listed in Appendix VIII that are in the waste will not pose a substantial threat to human health or the environment, and should not be tested for during ground-water monitoring.

A review of the Part A hazardous waste permit applications filed with the TDWR indicates that many facilities for which applications were filed may not, in fact, need permits. For example, some applications for facilities which do not manage hazardous waste were submitted as "protective filings," while others were filed for facilities which may now be excluded from permit requirements. The latter is particularly true for facilities which generate and store, but neither process nor dispose of hazardous waste on-site. For example, these facilities do not need a permit if they qualify for the "Accumulation Time" (90-day storage) or the "Small Quantity Generator" storage exclusion. Please review your facility operation to determine if a hazardous waste permit is required. If no permit is required, please complete the enclosed Affidavit of Exclusion and return it to the Solid Waste Section at the TDWR within 30 days of the date of this letter, in lieu of the Part B and Part A deficiencies requested above.

Should you have any questions or desire to arrange a conference in Austin to discuss the application in detail, please contact Jeff Webb of my staff at AC512/475-2041.

Sincerely,

Jay Snow, P.E., Chief
Solid Waste Section

JW:rmc/bb
Enclosures
cc: TDWR District 7 Office - Deer Park

DENKA Chemical Corporation 8701 Park Place Blvd. 77017 • P.O. Box 87220 Houston, Texas 77287 (713) 477-8821 Telex 77 46 96

May 29, 1984

SWR 31052

Mr. Paul F. Lewis
Texas Department of Water Resources
P. O. Box 13087, Capitol Station
Austin, Texas 78711

Dear Mr. Lewis:

Status Report - Groundwater Quality Assurance Plan

The following letter is a status report of Denka Chemical Corporation's Groundwater Quality Assurance Plan. At the end of the first year of groundwater monitoring, compilation of the data indicated some significant differences between Denka's upstream well and the four downstream monitoring wells. As a result of this significant difference, Denka submitted a Groundwater Quality Assurance Plan which was accepted by the Texas Department of Water Resources. The first two well samplings of this plan have been accomplished and this status report will summarize the results of those samplings.

Our Groundwater Quality Assurance Plan had four objectives: The first was to determine levels of contamination in groundwater at the Denka site; the second was to determine the extent of contamination; the third objective was to determine the direction of groundwater flow; the final objective was to determine, if possible, the source of contamination. In order to accomplish these objectives, two additional monitoring wells were drilled. The purpose of these two wells was to monitor the aquifer below those aquifers deemed contaminated by the original year's well water monitoring.

The two new wells were located adjacent to two wells used in the original monitoring program. the two original wells were screened in the 5- to 10-foot above mean sea level depth. The two new wells were screened at 45 to 50 feet below mean sea level. One of the original wells was located at the perimeter of the plant; the second one was near the maleic unit within the boundaries of the plant. The purpose of these two wells was to measure the extent of contamination in the 45- to 50-foot below sea level aquifer.

Our Groundwater Quality Assurance Plan called for component analysis to determine the materials most likely to show up in contaminated water sources from the Denka plant. Specific materials that Denka felt were possible contaminants included maleic acid, fumaric acid, 3,4-dichlorobutene-1, 1,4-dichlorobutene-2, chloroprene, 1-chlorobutadiene, and xylene.

The basis for analyses of these materials was ion chromatography and mass spectroanalysis. The well samples were analyzed by NUS Corporation. There is a question in the minds of chemists at NUS whether maleic acid and fumaric

acid can be analyzed by these methods. At this point, no approved method of analysis of these materials has been found.

Groundwater samples analyzed by reconstructed ion chromatographs indicate volatile materials of various types as distinct peaks on the chromatographs. The specific peaks were identified by mass spectroanalysis. The data received from the mass spec analysis was compared against 30,000 materials whose spectrum is known. The fact that none of the significant RIC peaks were identified as the components that Denka felt might be possible contaminants indicate that these compounds were not present in significant or measurable amounts. The materials that were identified are shown in the attached table. Most of these materials are shown to be insignificant quantities or within reasonable analytical limits. Of the materials which did appear to be significant, none were compounds which would reasonably be expected to come from the Denka facility. This is further indicated by the fact that these components also showed up in Denka's upstream monitoring well.

Indicated parameters were run on all seven wells. As shown by the results on the attached table, the indicated parameters for the shallow wells are approximately the same as they have been during the first year's sampling. These parameter analyses for the two wells show very good water quality.

The conclusions that we have reached from the results of the Groundwater Quality Assurance Program at this point are as follows:

1. Groundwater quality in the uppermost aquifer remains approximately the same as it has for the past year.
2. Groundwater quality in the two new wells screened at 45 to 50 feet below mean sea level is good.
3. Materials identified in the upper aquifer are materials that would not reasonably be expected to originate at the Denka facility.
4. Components which could be expected to be in contaminated aquifers from the Denka facility have not been detected.

The third quarter groundwater sampling will be made approximately mid-June. As soon as the results of this sampling have been tabulated, a final report will be issued.

Should you have any questions concerning the data submitted in this status report, or any other aspect of our Groundwater Quality Assurance Plan, please do not hesitate to contact me.

Very truly yours,

R. E. Hinkson
Manager of Quality Assurance

bf

TEXAS DEPARTMENT OF WATER RESOURCES
1700 N. Congress Avenue
Austin, Texas

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Paul Hopkins, Chairman
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Ralph Roming

June 29, 1984

Dick Dixon

Mr. Robert Hinkson
Denka Chemical Corp.
8701 Park Place Blvd.
Houston, Texas 77017

Dear Mr. Hinkson:

Re: Solid Waste Registration No. 31052

The Department's review of your Groundwater Plan under 31 Texas Administrative Code Section 335.194(d) indicates that a Groundwater Compliance Plan Application is required for your facility as per 31 Texas Administrative Code Section 335.465. The enclosed application should be submitted with your Part B Permit Application.

If you have any questions, please contact Ms. Ann McGinley or Mr. Bob Lee at 512/475-5695.

Sincerely,

Bryan W. Dixon, P.E., Chief
Solid Waste and Spill Response Section
Enforcement and Field Operations Division

MGD:lk

Enclosure

cc: Mr. Jay Snow, Permits Division, Solid Waste
Ms. Joy McGee; Solid Waste Enforcement and Spill Response
Texas Department of Water Resources District 7 Office

DENKA Chemical Corporation 8701 Park Place Blvd. 77017 • P.O. Box 87220 Houston, Texas 77287 (713) 477-8821 Telex 77 46 96

September 21, 1984

Mr. Paul Lewis
Solid Waste & Spill Response Section
TEXAS DEPARTMENT OF WATER RESOURCES
P. O. Box 13087, Capitol Station
Austin, Texas 78711

Dear Mr. Lewis:

Enclosed you will find the final report on the Denka Chemical Corporation Groundwater Quality Assessment Plan.

If you have any questions, please do not hesitate to contact me.

Sincerely,

Robert E. Hinkson

Robert E. Hinkson
Manager of Quality Assurance

bf
Enclosure

31052

RECEIVED
JUL 19 '83
ENFORCEMENT AND
FIELD OPERATIONS

DENKA USA

Attachment D-2

DENKA Chemical Corporation 8701 Park Place Blvd. 77017 • P.O. Box 87220 Houston, Texas 77287 (713) 477-8821 Telex 77 46 96

CB → Bryan

July 15, 1983

SY

BBB File

Mr. Charles E. Nemir
Executive Director
Texas Department of Water Resources
P.O. Box 13087, Capitol Station
Austin, Texas 78711

31052

Dear Mr. Nemir:

Denka Chemical Corporation has completed the initial sampling for the second year under the Ground Water Monitoring Program. The results were compared with the first year background analyses. A significant difference (as indicated by the Student's T Test) between the background and the current data was found.

As required by TDWR regulations, the wells were immediately resampled, the samples split and reanalyzed. The results still indicate that the comparison between up gradient and down gradient wells is significant.

This letter is to notify the TDWR that our facility may be affecting ground water quality and that Denka Chemical Corporation will prepare a ground water quality assessment program within the next 15 days.

Should you require any additional information, please do not hesitate to let me know.

COPY TO [illegible] 7
7/21/83 [illegible]
SENT

Robert E. Hinkson
Industrial Relations Manager

/ah

GEO ASSOCIATES

Geotechnical Engineering & Groundwater Hydrology

GROUNDWATER QUALITY ASSESSMENT PLAN

Denka Chemical Corporation
Houston, Texas

SWR 31052

Attachment D-3

10701 Corporate Drive, Suite 282 • Stafford, Texas 77477 • (713) 491-4826

GEO ASSOCIATES

Geotechnical Engineering & Groundwater Hydrology

August 3, 1983

Geo Associates Job No. 003

Denka Chemical Corporation
P.O. Box 87220
Houston, TX 77287

ATTN: Mr. Bob Hinkson

Dear Mr. Hinkson:

Geo Associates is pleased to submit to you a Groundwater Quality Assessment Plan for the Houston Plant. I, Wayne S. Pollard, a geotechnical engineer, do hereby certify that the attached plan meets or exceeds the requirements of the Texas Department of Water Resources Rules 156.22.12.004(d)(2) and (d)(3).

If you have any questions concerning this plan, please contact me.

Sincerely,

Wayne S. Pollard, Ph.D., P.E.
Principal

WSP/sp

attachment

Groundwater Quality Assessment Plan
Denka Chemical Corporation

MINIMUM REQUIREMENTS

Determinations Required:

(1) Rate and extent of migration of hazardous waste or hazardous waste constituents in the groundwater;
(2) Concentrations of the hazardous waste or hazardous waste constituents in the groundwater;

Specific Data Required:

(1) Number, location and depth of wells;
(2) Sampling and analytical methods for those hazardous wastes or hazardous waste constituents in the facility;
(3) Evaluation procedures, including any use of previously-gathered groundwater quality information;
(4) A schedule of implementation.

LISTINGS OF REQUIRED DATA

1. Well information
   a. Existing Wells - see Table 1
   b. Proposed New Wells - see Table 2
2. Hazardous waste constituents in the facility - see Table 3
3. Sampling Procedures - see Exhibit 1
4. Analytical Procedures - see Exhibit 2
5. Evaluation Procedures:
   a. Listing of previously-obtained data used in evaluation - see Table 4
   b. Evaluation - see "Procedures for Determinations"
   c. Schedule of Implementation - see Exhibit 3

PROCEDURES FOR DETERMINATIONS

The determinations required include (1) the rate and extent of migration of hazardous waste or hazardous waste constituents in the groundwater, and (2) the concentrations of the hazardous waste or hazardous waste constituents in the groundwater. Some of the data required to make these determinations have already been collected by Denka Chemical Corporation. This discussion of procedures is presented in three parts:

(1) Analytical approach for calculation of the rate of migration;
(2) Methods of determining extent of migration;
(3) Monitoring frequency.

Analytical Approach for the Calculation of Rate Movement

The uppermost aquifer at Denka Chemical Corporation is an erratic silt stratum typically 2 to 6 feet thick encountered at about 5 to 35 feet below ground surface. This aquifer apparently fingers and dips in various directions, making a simple stratigraphic model inapplicable.

Piezometers and monitoring wells have been installed within the uppermost aquifer, and the highly variable depths of screening are the result of the complex stratigraphic character of this site.

Flow in the uppermost aquifer is generally to the west or southwest, although local mounding of groundwater is observed adjacent to the aerated NPDES-regulated ponds operated by Petro-Tex and in the north-central area of the plant near the boundary with Goodyear.

Where seepage from hazardous waste units is indicated, calculations of flow quantity will be based on Darcy's Law:

$$Q = kiA, \text{ where}$$

Q = flow quantity

k = hydralic conductivity (coefficient of permeability)

i = hydraulic gradient

A = cross-sectional area of flow

The above parameters will be evaluated at each potential hazardous waste unit seepage location from the following data:

Parameter	Data sources for Evaluation
k	Laboratory permeability tests, field pumping tests, site observations
i	Water level measurements in piezometers, wells, surface impoundments, etc.
A	Boring logs and site observations

Calculations of flow velocity to obtain rate of migration will be based on estimated aquifer porosity and a conservative tracer, except for constituents known to be readily attenuated by flow through such an aquifer. Flow rate of the latter constituents will be separately treated.

Calculations of seepage of constituents migrating via density gradients will be separately treated.

Methods for Determining Extent of Migration

Horizontal

The extent of horizontal migration of waste constituents in the uppermost aquifer will be evaluated within the plant boundaries. The ionic constituents within the waste will be assumed to migrate in response to the hydraulic gradient. Where these constituents are detected in wells that are upgradient from the presently active impoundments, other non-RCRA sources of the constituents will be investigated.

Alternative sources of hazardous waste constituents will be explored in detail in the GQAP by means of site records review, site investigations by boreholes and wells, analyses of early (1917 era) USGS topographic gradrangles as compared to present topography, and off-site data (if available), etc.

Rationale for attributing constituent concentrations to non-regulated units include: (1) a possible spike of TOX travelling across the plant during the past 2 years; (2) the potential for surface spills to cause

contamination of the uppermost aquifer where it tops within a few feet of the ground surface; (3) the potential for leaky sewers, constructed in the WWII era, to contribute to groundwater contamination; (4) the possibility that some of the waste constituents could be attributable to off-plant sources in this heavily industrialized section of Houston.

Certain non-ionic or heavy ionic constituents in the waste may have a higher specific gravity than water. These constituents may migrate in response to a density gradient rather than a hydraulic gradient, thus presenting special considerations in detection and migration studies. Dipping aquifers or sand bodies cutting through horizontal aquifers can provide avenues for flow of these constituents in directions not associated with the measured hydraulic gradients in those aquifers. Determinations of rate and extent of migration of these constituents if present, will be treated separately from the ionic constituents.

Vertical

The vertical extent of migration includes the movement of constituents from upper to lower aquifers as well as the previously discussed density migration of constituents. The vertical extent of migration into lower aquifers will be addressed by screening the "next lower aquifer" with two wells. The well construction will be carefully controlled to completely separate the aquifers along the borehole (see Exhibit 4).

It is anticipated that two additional double-cased, fully penetrating 4-inch diameter (internal casing) PVC wells with 0.010 inch slotted screen, sand packed, bentonite sealed, and grouted up to the ground surface with a pumped cement/bentonite grout will be installed at locations discussed in Table 2 in the "next lower aquifer" to supplement the data obtained previously in the uppermost aquifer.

The wells discussed above will be developed with compressed air and subsequently pumped and sampled several times for the hazardous waste constituents of concern. The results in the two aquifers will be compared to evaluate the possibility of vertical migration of the hazardous waste constituents. Water levels will be observed over time to allow a preliminary assessment of gradient within the "next lower aquifer" using only 2 points, and by comparison of the shapes of the curves of water levels vs. time of various wells, the probable connections between aquifers.

If it is determined from multiple samplings that the "next lower aquifer" is uncontaminated by hazardous waste constituents, then sampling intervals will be established to monitor the aquifer over the long term to detect any future contamination. If contamination is indicated in both aquifers, additional monitoring wells will be considered in the lower aquifer.

Monitoring Frequency

Wells installed under this program, along with the previously installed wells, will be sampled on a quarterly basis for three quarters and the samples analyzed for the constituents shown in Table 3 prior to making the initial determinations required of a GQAP. This will allow multiple water level observations to evaluate seasonal responses, well pumping tests to evaluate k, sample analyses, and, if appropriate, limited modeling of the aquifer system prior to concluding that one or more aquifers are significantly contaminated by RCRA-regulated facilities.

The two wells in the next lower aquifer will serve to indicate possible contamination, possible degree of connection to the uppermost aquifer, and some gradient information, but a gradient within the aquifer cannot be properly established from only two points of observation.

The analyses of the data obtained should be available within less than one year of initiating the GQAP. At that time it should be possible to quantitatively determine the approximate probable extent of migration unless there is strong evidence that the lower aquifer may contain waste constituents.

If wells are determined to have minimal constituent concentrations, then monitoring frequency will be reduced to semi-annual or annual, as appropriate.

TABLE 1

EXISTING MONITORING WELLS

Well No.	Top of Pipe Elevation	Elevation of Screened Interval	Location
1	16.58	6.3 to 2.3	Downgradient, northwestern corner of plant
2	16.15	3.5 to -2.5	Downgradient, west of impoundments
3	22.13	8.2 to 5.2	East of impoundments, west of Well No. 4
4	28.48	8.0 to -2.0	Upgradient Well in north central plant area
5a	19.37	-18.0 to -24.0	Downgradient, south of impoundments

NOTES:

1. All elevations are in ft. above msl (1978 NGS releveling datum).
2. Top of pipe elevation is about 2 feet above ground surface elevation except for Well 4 which is 3.5 feet above ground surface.

TABLE 2

Proposed New Well Locations

Denka Chemical Corporation

The following new wells are designed to penetrate a potentially contaminated aquifer and screen a lower aquifer of unknown water quality. They are double-cased and constructed in accordance with Exhibit 4.

WELL NO.	LOCATION
21	Near existing Well No. 3
22	Near existing Well No. 2

TABLE 3

LISTING OF HAZARDOUS WASTE CONSTITUENTS THAT MAY BE PRESENT IN IMPOUNDMENTS

Maleic Acid

Fumaric Acid

3,4-Dichlorobutene-1

1,4-Dichlorobutene-2

Chloroprene

1-Chlorobutadiene

Xylene

TABLE 4

Listing of Previously-Obtained Data on Groundwater Quality Information

1. Quarterly sampling results for Wells 4, 1, 2, 3, 5A

   a. Measurements of indicator paramters
   b. Primary Drinking Water Standards
   c. Groundwater quality standards

   NOTE: Well No. 5A was constructed between the first and second quarterly samplings, so data exists only for the second and subsequent quarters for this well.

2. Water quality analyses
   a. Maleic Pond fluid and sludge
   b. NPDES discharge points
   c. Internal sampling of various wells and piezometers on the plant

3. Espey, Huston & Associates, Inc. Phase I Report on Groundwater Monitoring and subsequent letters

4. Geo Associates report on groundwater monitoring, March 1983

Exhibit 1

SAMPLING PROCEDURE FOR GROUNDWATER MONITORING

Prior to the actual sampling of any monitoring wells, Geo Associates collects and delivers the PVC sample bailers to the NUS Corporation located in Clear Lake City, Texas, for laboratory cleaning. The bailers are scrubbed with soap and water, rinsed with de-ionized water, and the process is repeated. The clean bailers are then picked up by Geo Associates on the day the groundwater monitoring is scheduled.

Each well is sampled individually by Geo Associates representatives. A water level measurement is taken at each well location using a mechanical "popper" and recorded in the daily log book. A submersible stainless steel pump is then lowered down the well to the maximum allowable depth. At least three (3) casing volumes of water are evacuated prior to sampling. Once the submersible pump is removed, the well is allowed to recover before a sample is taken. A clean PVC sample bailer is lowered down the well with a clean cable. The sample is then poured into sterile bottles containing appropriate preservatives as required, provided by the NUS laboratory. The sample bottles are labeled with the client name, date and well number and stored in an ice chest to preserve the samples during transport to the laboratory.

At no time is a PVC sample bailer used in more than one well during any one sample period, nor is any cable used in more than one well.

A Chain of Custody form is maintained with the samples. The completed Chain of Custody form is then returned to Geo Associates by NUS and forwarded to the client.

EXHIBIT 2

ANALYTICAL PROCEDURES

The following hazardous wastes or hazardous waste constituents may exist in the waste impoundments at the Denka Chemical Corporation plant in Houston, Texas. They will be monitored, as appropriate, in wells and analyzed using the following procedures:

Parameter	Proposed Methodology
Maleic Acid	Ion Chromatography or Liquid Chromatography
Fumaric Acid	
3,4 - Dichlorobutene - 1	Gas Chromatography / Mass Spectrometry
1,4 - Dichlorobutene - 2	
Chloroprene	
1 - Chlorobutadiene	
Xylene	

EXHIBIT 3

SCHEDULE OF IMPLEMENTATION

All dates are relative to Date of Submission (DOS) of GQAP to the TDWR:

DOS + 6 weeks:	Complete installation of two monitoring wells (double cased) in the "next lower aquifer".
DOS + 8 weeks:	Complete first quarterly sampling of all site wells for waste constituents noted in Table 3.
DOS + 14 weeks:	Complete field work for well pumping test in uppermost aquifer.
DOS + 20 weeks:	Complete second quarterly sampling of all site wells; evaluate probability that constituents in wells are from non-RCRA sources.
DOS + 32 weeks:	Complete third quarterly sampling of all site wells.
DOS + 36 weeks:	Evaluate necessity of site modeling by computer.
DOS + 45 weeks:	Complete preliminary evaluation of extent and rate of migration of constituents in uppermost aquifer; complete preliminary evaluation of probability of significant migration of constitutents into "next lower aquifer".
DOS + 50 weeks:	Present data from results to date to TDWR and determine requirements for additional study. This is the "first determination" of the GQAP.

Exhibit 4a

DETAILED DISCUSSION OF WELL INSTALLATION THROUGH CONTAMINATED UPPERMOST AQUIFER

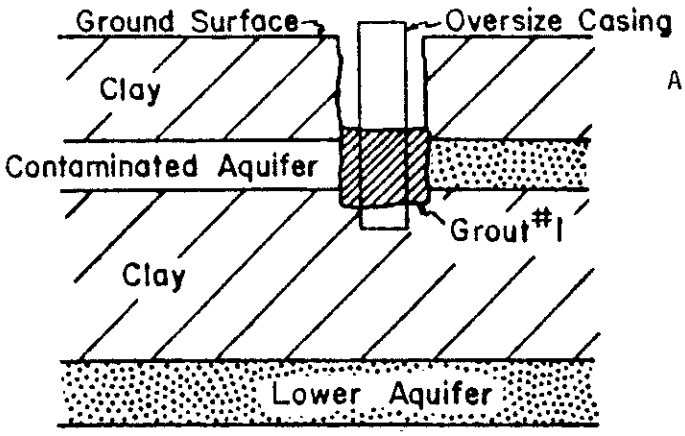
Special consideration is placed on the proper construction of a well in the next lower aquifer. Geo Associates has develped a technique for the installation of a well through a contaminated uppermost aquifer to the next lower aquifer by installing an oversized outer casing. This is accomplished by drilling a 10-inch diameter hole through the uppermost aquifer, filling it partially with sand/cement grout and pushing an 8-inch diameter PVC schedule 40 casing into the underlying clay to a typical depth of about 2 feet below the bottom of the 10" borehole. (See Exhibit 4b, Part A).

The drill crew will return the next day to drill down through the outer casing to the next lower aquifer using an 8-inch drill bit. When the next lower aquifer is encountered, a 4-inch diameter schedule 40 PVC well casing will be installed with the screened section located in the lower aquifer (see Exhibit 4b, Part B). The screen will then be packed with sand using a tremie pipe.

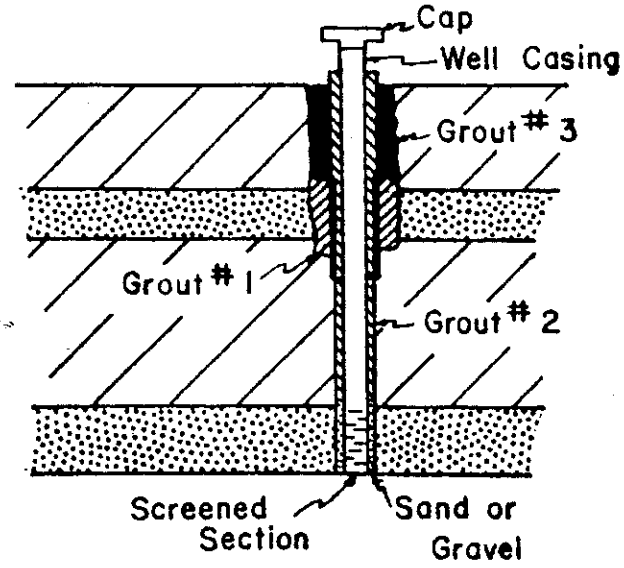
The top of the sand pack is located by plumbing down the annular space between casing and borehole to confirm that it is above the top of the screen. A bentonite pellet seal is then placed above the sand and a pumped cement/bentonite grout placed above the bentonite up to ground surface.

Exhibit 4b

PROCEDURE FOR INSTALLING SHALLOW WELL THROUGH A CONTAMINATED UPPER AQUIFER



A.
1. Drill large diameter hole completely through uppermost aquifer.
2. Pour in Grout #1, and press oversize casing at least 6 inches into underlying clay while grout is wet.
3. Let Grout #1 set overnight.



B.
1. Drill through Grout #1 inside the oversize casing and drill into Lower Aquifer.
2. Install well casing with screened section at depth of Lower Aquifer.
3. Sand or gravel pack around screened section.
4. Pump in Grout #2 above sand/gravel pack and up to top of oversize casing.
5. Pour in Grout #3 above Grout #1 outside oversize casing.
6. Cap off top of well.

NOTE: Grout #3 may be placed at the same time as Grout #1.

Attachment D-4

TEXAS DEPARTMENT OF WATER RESOURCES

C O N F E R E N C E R E C O R D

SWR 31052

Project: DENKA Chemical Corp. - SWR 31052

Conference date: September 9, 1983 Place: SFA Bldg., Rm. 1029L

Type of conference: Informal Technical

(telephone, staff, formal or informal hearing, other)

Attendance:

Name	Agency
Robert E. Hinkson	Operations Manager - DENKA
Fred Dalbey	TDWR - District 7
Paul Lewis	TDWR - Austin

Summary:

This meeting was held to discuss the ground water quality assessment plan submitted on August 5, 1983. T-test results (attached) show significant differences in all downgradient wells. Map shows well locations and facilities which might be affecting ground water quality. DENKA does not consider the wastewater treatment system to be a hazardous facility.

Assessment program is adequate in its approach. Ground water flows to Sims Bayou - lateral extent of contamination in first shallow zone, if present, would be confined by bayou. Two additional wells proposed to test for deeper contamination. TDWR thought implementation schedule was too long. DENKA agreed to submittal of a progress report after 20 weeks, as well as cosampling of wells with TDWR and making results of analysis available. TDWR will send follow-up letter.

PSL:py

Attachments

cc: Texas Department of Water Resources District 7 Office

Prepared by: Paul S. Lewis

Attachment D-5

TEXAS DEPARTMENT OF WATER RESOURCES

C O N F E R E N C E R E C O R D

Project: Denka Chemical Corp. SWR 31052

Conference date: May 18, 1984 Place: Rm 1028A SFA Bldg

Type of conference: Technical
(telephone, staff, formal or informal hearing, other)

Attendance:

Name	Agency
Robert E. Hinkson	DENKA
Paul Lewis	TDWR - CYFO
Jeff Webb	TDWR - Permits

Summary: Purpose of meeting was to update staff on status of assessment program and submittal of Pt B application, both delayed by employee purchase of plant from parent company. Maleic acid from listed waste (TOXIC, U147) maleic anhydride isomerizes to fumaric acid in water. Reaction goes to equilibrium, some of both will be present in water. Other likely constituents include Chloroprene; 3,4-dichlorobutene-1; 1,4-Dichlorobutene-2 (in decreasing order of concentration). Wastewater has TOC range of 600-4000 ppm, pH 1-2, dark color, readily biodegradable. Co. claims contract labs can't analyze for maleic acid. Their plant lab can detect down to ~ 0.1% by titration.

Preliminary review of results during meeting do not appear to indicate a problem, as most chlorinated hydrocarbons on priority pollutant list were below detection limits. Some substances identified in concentrations on order of 100 ug/l or less in up-gradient and down-gradient wells. Co. claims these substances are not found in their processes or wastes. Assessment would be more convincing with analysis for maleic acid/fumaric acid. I instructed Co. to: (A) Submit status report within 2 weeks to include (1) analyses to date (2) proposed action for finding analytical method. (B) Conclude assessment on schedule by August 1984 for incorporation into Pt B permit drafting process.

Prepared by: Paul J. Lewis

cc: O-7

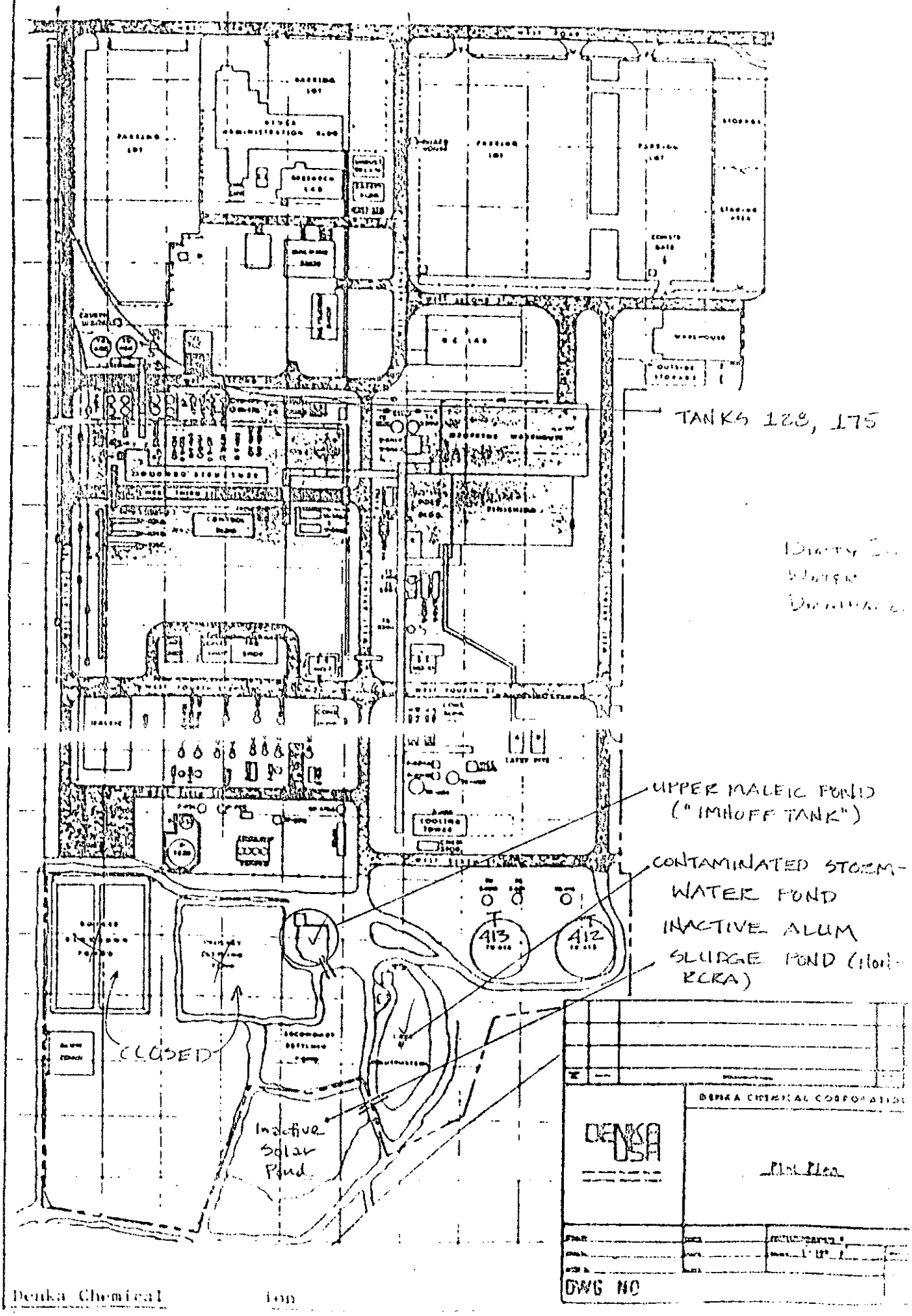
2. The logs from the existing wells at the facility should be submitted to the Commission. In addition, the total depth well of GWM-1 should be verified.

   Denka should provide to the Commission justification for the location and completion interval of the present monitoring well system or a proposal for installation of additional wells which will provide adequate detection of waste constituents in the uppermost aquifer. It appears that the horizontal spacing of the detection monitoring wells is too large to satisfy 40 CFR.264 performance language.

3. Submit an estimate or calculation of the rate and extent of migration of the hazardous waste or hazardous waste constituents in the ground water. Such determination should also be made for the previous year.

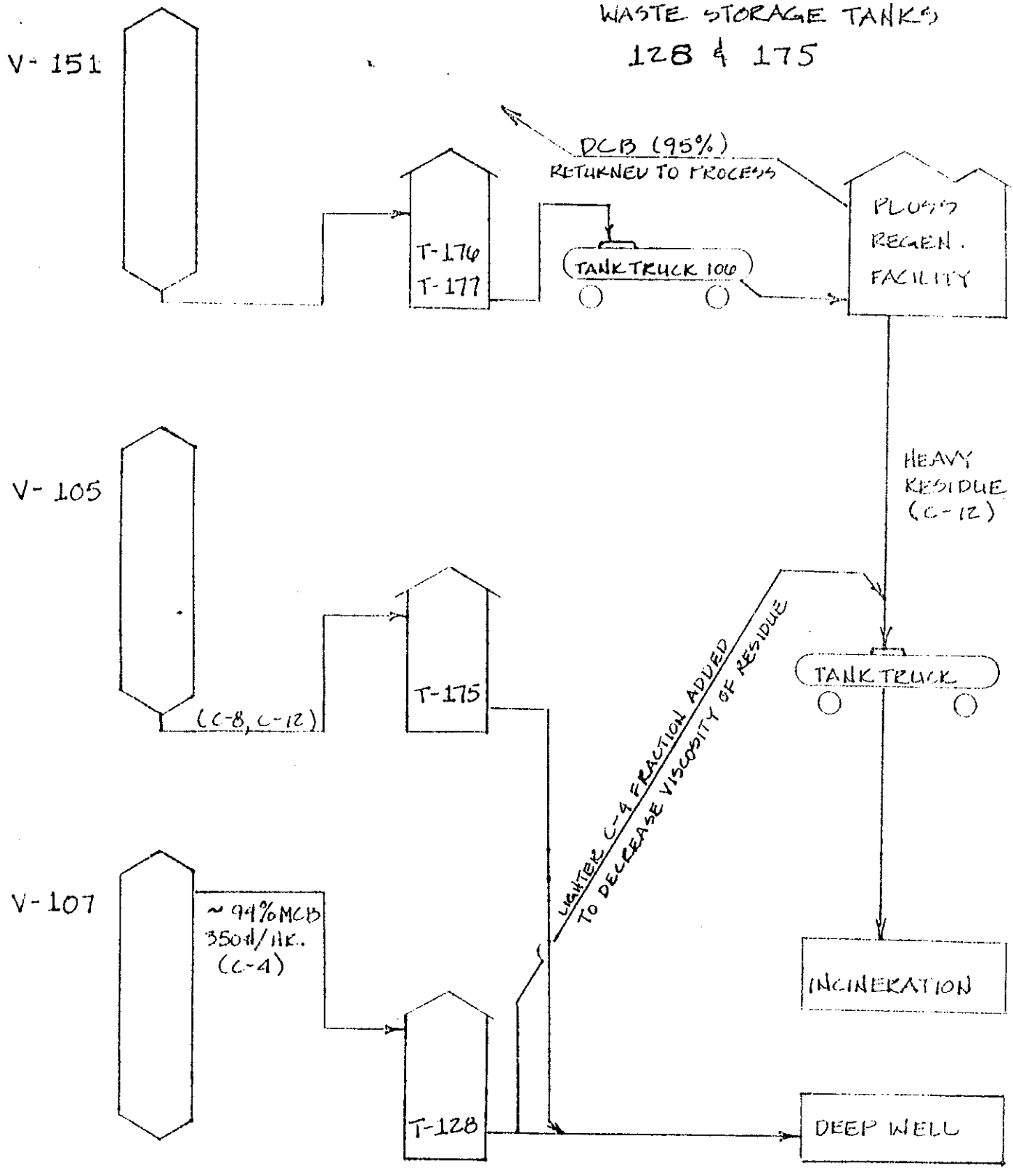
ATTACHMENT C

Figure II



Denka Chemical Corporation

WASTE STORAGE TANKS
128 & 175



Texas Department of Water Resources District No. 7
DENKA CHEMICAL CORP. 31052 MANAGEMENT OF WASTE CHLORINATED HYDROCARBONS

CME

FILE ID A

TWC Reg. No. 31052

TEXAS WATER COMMISSION
Comprehensive GW Monitoring Evaluation (CME) Report

INSPECTION COVER SHEET

C.O.Use Only

Date Entry Date

EPA ID No. TXD084912177

NAME OF COMPANY Denka Chemical Corporation

SITE ADDRESS 8701 Park Place Boulevard Tel 713-477-8821

COUNTY Harris TYPE OF INDUSTRY Chemical manufacturing complex producing neoprene and Maleic anhydride

Current GW Monitoring Status: quarterly assessment analyses

(Specify for each Waste Management Area "WMA")

Inspection Information:

Inspector(s) Nancy Bob Date(s) 1-23-86

Participants Clarence Johnson, District 7, Mr. Bob Henkson, Denka

Type of Inspection (check) EV ___ CME ✓ SA ___

Evaluation:	S	U
A. Monitoring System	___	X
B. Sampling Procedures	*	___
C. Analysis & Results	*	___
D. Records & Response	___	X

Signed: Nancy Bob
Inspector
Date: 2/27/86

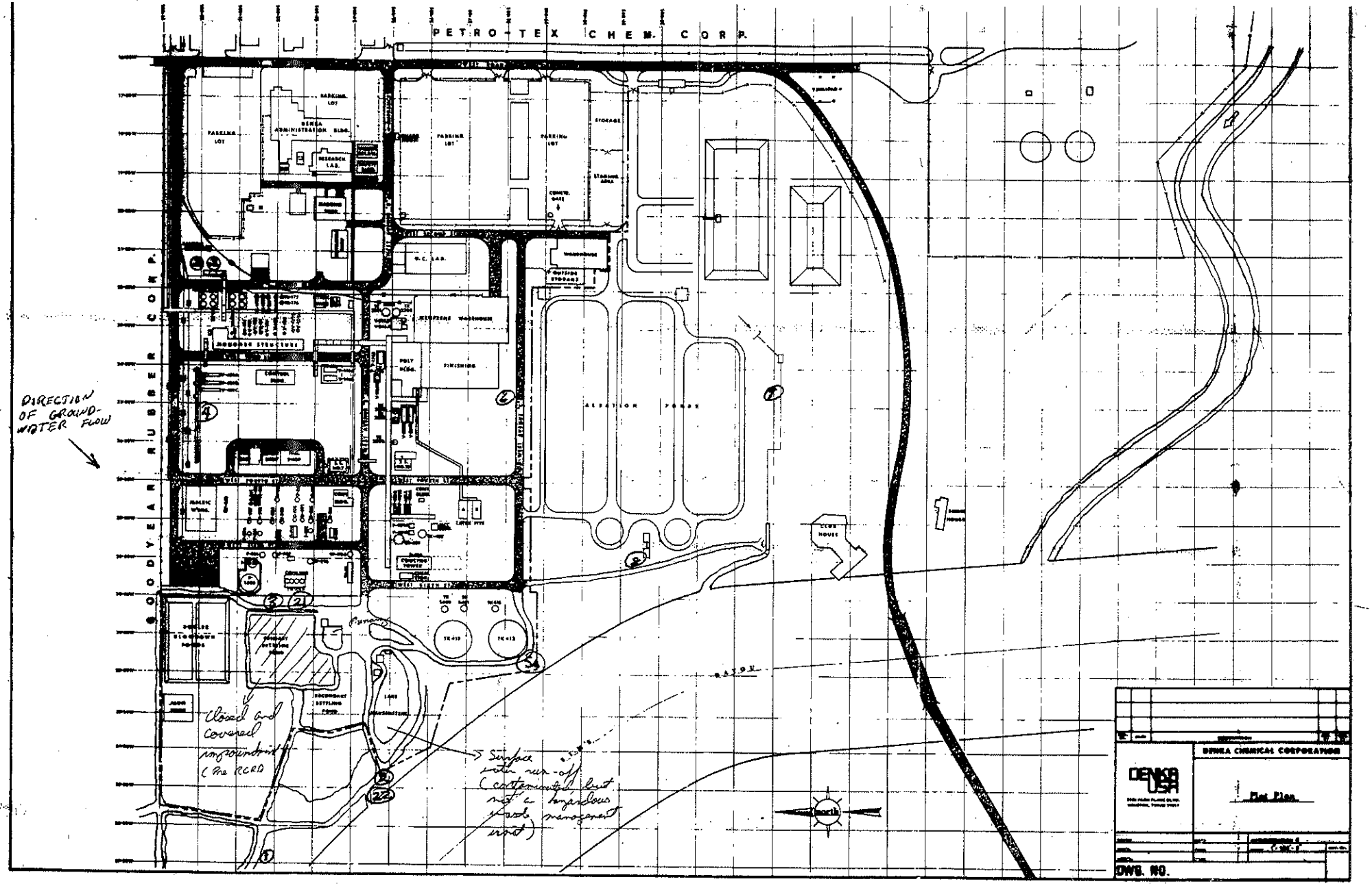
Signed: Paul L. Lewis
Reviewer
Date: 2/28/86

S= Satisfactory U= Unsatisfactory

Overall Evaluation: Compliant ___ NonCompliant X

* The sampling event was completed on February 25, 1986. This event will be addressed under separate cover.

01/86


PETRO-TEX CHEM. CORP.
GOODYEAR RUBBER CORP.
DIRECTION OF GROUND-WATER FLOW
DENKA CHEMICAL CORPORATION
Plot Plan
DWG. NO.
closed and covered impoundment (One RCRA
Surface water run-off (contaminated but not a hazardous waste management unit)